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November-December 1953

METAL TREATING

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MASTER CRAFTSMEN
METAL TREATING INSTITUTE

An interior view of the modern heat treating facilities at Cook Heat Treating Company of Texas. Inset—View of exterior of plant and offices.

THE ONLY MAGAZINE DEVOTED EXCLUSIVELY TO THE HEAT TREATING INDUSTRY

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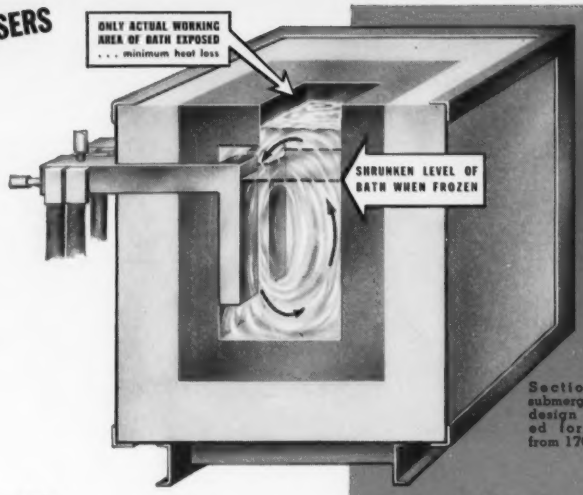
. . . and dozens of others



Sectional view of submerged electrode design recommended for operations from 1700°to 2400°F.

THE Proved Practice FOR HARDENING TOOLS AND DIES

(High Speed, High Carbon-High Chromium, Stainless and Carbon Steels)

When such an imposing array of the world's leading makers of high speed tools and dies adopt the same heat treating method and equipment, you can count on it that there's a reason—several reasons in fact.

Productive capacity is two or three times that of other heat treating methods because of faster heating.

Distortion is negligible.

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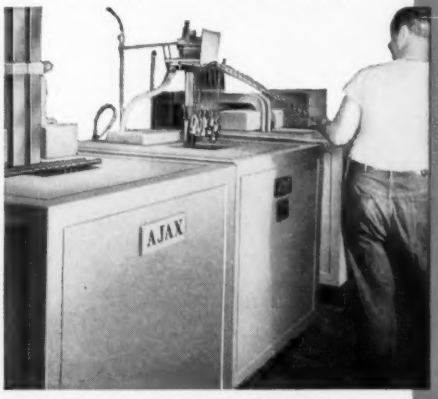
The life of tools is increased from 25% to 300% over those heated by ordinary methods.

Adaptability—The Ajax Salt Bath handles any type of high speed, carbon or alloy tool and die steel. Moreover, it occupies less floor space, does not require a skilled operator and provides maximum protection and long life for pots.



Typical installation for hardening high speed tools. Preheat, high heat and quench furnaces. The center unit operating at 2350°F. is equipped with submerged electrodes (see illustration at upper right). Preheat and quench units have suspended electrodes.

Through this unique and patented Ajax submerged electrode design, the efficiency of salt bath hardening is increased in the following ways:

Power Consumption Decreased as Much as 30%—Only the *actual working area* of bath exposed.

Electrode Life Greatly Extended—Electrodes not exposed to severe oxidizing action at surface of bath.

Bath Rectification Simplified—Oxides and dross materially reduced due to restricted bath surface.

Restarting is Easy—Closely-spaced electrodes melt salt from top downward. No danger of sealed-in pressure. No damage to pot or electrodes.

Accurate Temperature Control—Electrodynamic circulation assures temperature uniformity within ±5°F throughout bath.

Overheating of Work Eliminated—Electrodes closely-spaced, set against back wall of furnace, prevent heating current from entering work. Entire bath depth available for work.

Salt Leaks Prevented—Complete outer steel casing.

Easier Charging and Discharging—Furnace top is unobstructed.

Write for Ajax Bulletin 123B

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940 Frankford Ave., Philadelphia 23, Pa.

THE WORLD'S LARGEST MANUFACTURER OF ELECTRIC HEAT TREATING FURNACES EXCLUSIVELY

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AJAX HULTGREN **ELECTRIC SALT BATH FURNACES**

Editorial...

NOW IS THE TIME!

Here are three headlines from the Wall Street Journal (December 1, 1953):

1. "Manufacturers Sales in October Topped '52 But Orders Fell Sharply"
2. "Steel Mills' Operations . . . 86.8%, Lowest In Over a Year"
3. "Steel Scrap Heaps Higher In Mill Yards as Furnaces Consume It at a Slower Pace."

Bad? Well it's not good—but—there is a challenge in them for all industry and particularly the Commercial Heat Treater.

Commercial Heat Treating is possibly one of the youngest of the nation's *service* industries. It is a natural product of metalworking's need for an accumulation of skills and facilities under one roof—a department store where industry can select the equipment and abilities to achieve its specifications without costly investment and long, wasteful training periods.

Because of a rather painful and rapid adolescence into current maturity (hastened by the abnormal stimulation of two wars) the industry has missed some of the basic training in selling and market development so well understood by the rest of metalworking.

For all too many years now, business for the Commercial Heat Treater has been largely a matter of "over the transom" from which they could pick and choose. "Capacity" could not keep up with "demand" and many wasteful and unneeded "in-plant" installations were made. (This, of course, does not mean there is no proper place and time for departmental installation or expansion.)

The point, which we now reach and hope will start a chain reaction of thought and action, is that "Now is the Time" for the Commercial Heat Treater to begin to apply some of the good old fashioned principles of "SELLING" by telling the world who he is, what he is, where he is, and what he can do.

Readjustments were inevitable and are here today. They are both a challenge and an opportunity, not a reason for "calamity howling."

Merry Christmas and a Happy, "Prosperous" New Year to all!

C. E. Herington

METAL TREATING

Official Journal of the Metal Treating Institute

National Trade Association of Commercial Heat Treaters

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HORACE C. KNERR, *Chmn., Pub. Comm.*, Metlab Co., Phila., Pa.
C. E. HERINGTON, *Editor*
B. A. FLANAGAN, *Advtg. & Prod. Mgr.*,
JOHN J. CODELLA, *Business Mgr.*
271 North Ave., New Rochelle, N. Y.

SALES REPRESENTATIVES

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NOTE: The authors wish to acknowledge the kind cooperation of the American Foundrymen's Society in providing original material for this article.

Heat Treatment of
ALUMINUM CASTING ALLOYS

By **H. J. ROWE and W. E. SICHA**
Aluminum Company of America, Pittsburgh, Pa.

Heat treatment of many aluminum casting alloys will impart mechanical properties that are greatly superior to those of the same alloys in the as-cast condition. The various types of heat treatments employed, listed below, are identified by the letter "-T" plus a number, which is appended to the alloy designation. The suffix "-F" is used to identify the "as-cast" condition.

-T2 – Annealed
-T4 – Solution heat treated
-T5 – Artificially aged only
-T6 – Solution heat treated and then artificially aged
-T7 – Solution heat treated and then stabilized

Data on the mechanical properties and uses of heat treated aluminum casting alloys are generally available.[2,3,4,5,6] Details of the more generally used commercial heat treatments are given in Tables 1 and 2.

Casting Requirements—Castings must not only be of the specified chemical composition but also of good quality as a result of proper raw materials and correct foundry practice in order to obtain the expected response to heat treatment. This fact is generally appreciated, but it cannot be emphasized too strongly. Factors contributing to the production of sound and fine grained aluminum alloy castings are treated in other publications.[1,4,6]

Furnaces for Heat Treatment—Air-chamber furnaces of proper design are best suited to heat treatment of aluminum alloy castings. Furnaces may be heated by electric heating units, radiant tubes, or, if harmful products of combustion do not enter the heating chamber, by gas or oil burners. Gas furnaces in which the products of combustion are circulated, when suitably designed, can be used satisfactorily in many cases provided that the atmospheres contain a sufficiently high percentage of carbon dioxide and are free of sulfur compounds and excessive moisture.[7]

Furnace design should provide a uniform temperature within ±5 ° F. throughout the working zone. Mechanical circulation of the air is essential to accomplish this result and to decrease the heating cycle. Baffles generally are necessary to prevent air being circulated directly from the heating units onto the metal. For electrical resistance heating, units with a low energy input per unit of area are desirable.

Temperature Control—Furnaces should be equipped with recording pyrometers and automatic temperature control instruments to insure the necessary degree of control. Automatic limit controls that can be set at a temperature slightly higher than the operating temperature are also desirable to provide insurance against damage from accidental overheating through failure of the control equipment. All pyrometric equipment including the thermocouples should be frequently checked against standards.

Furnaces should be surveyed before putting them into service to make certain that the temperatures throughout the working zone are within the prescribed limits of ±5 ° F. This entails checking the temperatures through the heating cycle with several thermocouples placed in different locations in a typical charge of castings.

Annealing Treatment—Castings may be annealed for the purpose of relieving internal stresses which may be induced during casting production by contraction around resistant cores or by the differential cooling rates of sections varying in thickness. Annealing is also employed to bring about precipitation of alloying constituents from solid solution in which they may have been retained by a relatively rapid rate of cooling in production.

Thus, annealed castings have a structure that is practically insensitive to change at the temperatures ordinarily encountered in elevated temperature operation. They are not subject, therefore, to permanent dimensional changes in service.

Changes in the microstructure resulting from annealing may be visible but usually are not extensive. The microstructures of two commercial aluminum casting alloys shown in Figs. 1 and 5 are representative of annealed material, although both are of alloys in the "as-cast" condition.

The mechanical properties produced by annealing usually are similar to those of the "as-cast" material, although in some alloys tensile strengths slightly lower and elongations slightly higher than the "as-cast" properties result. As would be expected, this type of treatment has limited commercial application.

Solution Treatment—Casting alloys susceptible to solution heat treatment are those in which the solid solubility of an alloying element increases as the temperature increases. The soluble element or elements can be retained in supersaturated solid solution, after prolonged exposure at a temperature slightly below the melting range, by quenching the material rapidly to room temperature.

Aluminum-copper and aluminum-magnesium systems, which are of this type, constitute the basis for commercially important casting alloys. Magnesium and silicon form an intermetallic compound that has solubility characteristics similar to those of copper and magnesium. This compound forms a pseudo-binary system with aluminum, and casting alloys of this system are heat treated commercially.

In general, the solution treatment temperature for an alloy is limited by the solid solubility line and the eutectic or solidus temperature. Since the rate of atomic diffusion of the soluble constituent increases rapidly with increasing temperature, use

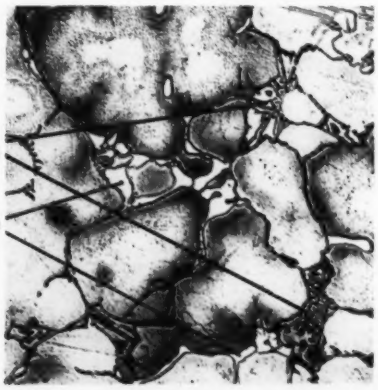


Fig. 1—Sand cast alloy 195 in "as-cast" (-F) condition showing characteristic cored structure and large quantity of (Al-Cu). Keller's etch. 250X.

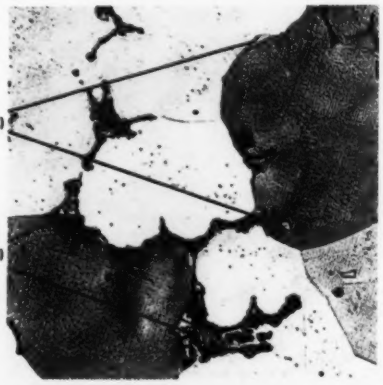


Fig. 2—Sand cast alloy 195 in solution heat treated (-T4) condition. Keller's etch. 250X.

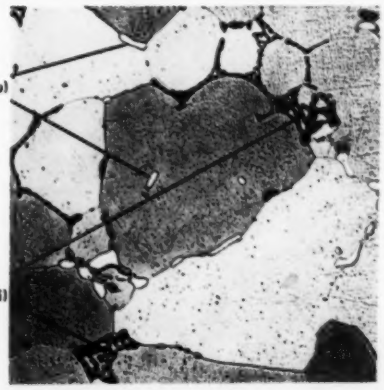


Fig. 3—Sand cast alloy 195 insufficiently solution heat treated with substantial amount of (Al-Cu) still undissolved. Keller's etch. 250X.

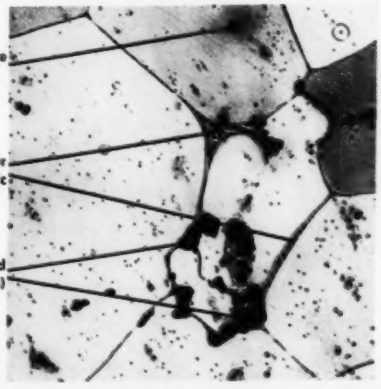


Fig. 4—Sand cast alloy 195 overheated in solution heat treatment exhibiting evidence of eutectic melting and insoluble constituent agglomeration. Keller's etch. 250X.

of the highest safe temperature is desirable. The maximum permissible temperature also may be governed by the strength of the alloy at the elevated temperature, since castings should be capable of retaining their shapes with little or no support during solution heat treatment.

Relatively long heating periods are required for solution of the soluble constituents in castings, even with the increased diffusion rate at the heat treating temperature. The time at temperature for attainment of homogeneity is less the shorter the distances through which diffusion must take place. Consequently, solution is more rapid in castings with a small macro grain size and fine dendritic structure. Hence, permanent mold castings can be treated in a shorter time than sand castings.

The rate of cooling from the solution heat treating temperature must be rapid in order to preserve at room temperature the solid solution that was in equilibrium at the heat treating temperature. However, an excessively rapid quench can cause extensive distortion through the setting up of excessive internal stresses. Commercial quenching practice is based upon maintaining the solid solution and minimizing the latter conditions.

Solution treatment materially increases the mechanical properties. Some of the physical properties such as density, and thermal and electrical conductivities also are altered by solution heat treatment, but to a degree that is generally unimportant except in special casting applications.

Microstructures of two solution heat treated commercial casting alloys are shown in Figs. 2 and 6. As an aid to the metallographer, Figs. 3, 4, 7 and 8, provide photomicrographs illustrating improper solution treatment.

Precipitation Hardening—A supersaturated structure, such as is produced by solution treatment, tends to adjust to equilibrium conditions. Alloy constituent or compound is precipitated from the solid solution in the course of this adjustment. The rate of precipitation is a function of temperature, since diffusion is essential to the progress of precipitation.

Precipitation in a solution treated alloy can be restrained almost indefinitely by keeping the material in liquid air. At such low temperatures, the atomic mobility is too low to permit the diffusion necessary for precipitate formation. The rate of

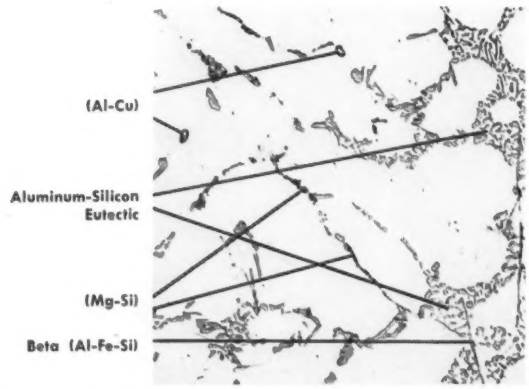


Fig. 5—Sand cast alloy 355 in "as-cast" (-F) condition showing aluminum-silicon eutectic and soluble constituents (Al-Cu) and (Mg-Si). 0.5% HF etch. 250X.

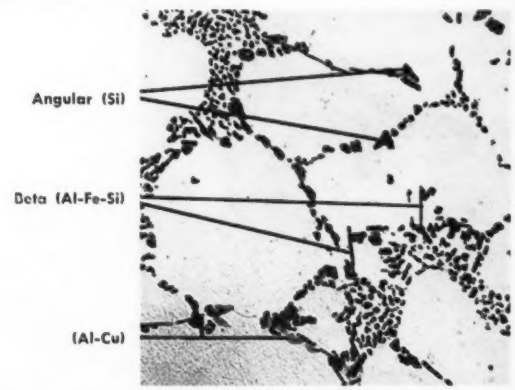


Fig. 7—Sand cast alloy 355 insufficiently solution heat treated with undissolved (Al-Cu) and still angular (Si). 0.5% HF etch. 250X.

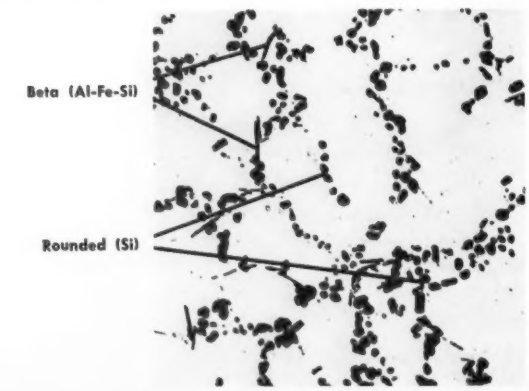


Fig. 6—Sand cast alloy 355 in solution heat treated (-T4) condition. 0.5% HF etch. 250X.

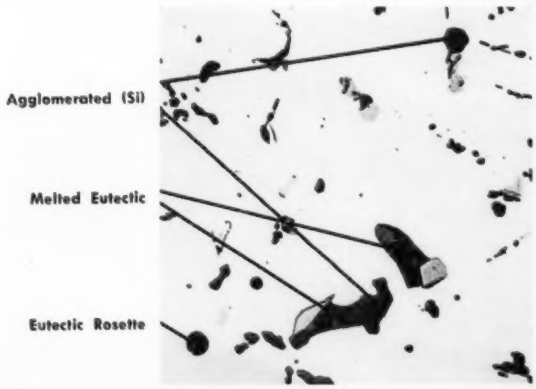


Fig. 8—Sand cast alloy 355 overheated in solution heat treatment exhibiting evidence of eutectic melting and (Si) agglomeration. 0.5% HF etch. 250X.

Table I—From "Casting Alcoa Alloys"

Alloy and Final Temper	Solution Heat Treatment ①		Artificial Aging Heat Treatment	
	Temp.—°F. ②	Time—Hrs. ③	Temp.—°F. ②	Time—Hrs. ③
122–T61	950	12	310	10–14
142–T21	....	....	650	2–4
142–T571	....	....	340	22–26
142–T77 ①	960	6	650	1–3
195–T4	960	12	....	....
195–T6	960	12	310	3–6
195–T62	960	12	310	12–20
319–T6	940	12	310	2–5
355–T51	....	....	440	7–9
355–T6	980	12	310	3–5
355–T7	980	12	440	3–5
355–T71	980	12	475	4–6
356–T51	....	....	440	7–9
356–T6	1000	12	310	3–5
356–T7	1000	12	400	3–5
356–T71	1000	12	475	2–4

Table II—From "Casting Alcoa Alloys"

Alloy and Final Temper	Solution Heat Treatment ①		Artificial Aging Heat Treatment	
	Temp.—°F. ②	Time—Hrs. ③	Temp.—°F. ②	Time—Hrs. ③
122–T551	....	....	340	18–22
122–T65	950	8	340	7–9
A132–T551	....	....	400	7–9
A132–T65	960	8	340	14–18
D132–T5	....	....	400	7–9
142–T571	....	....	340	22–26
142–T61	960	6	400	3–5
B195–T4	950	8	....	....
B195–T6	950	8	310	5–7
B195–T7	950	8	500	4–6
333–T5	....	....	400	7–9
333–T6	940	8	310	2–5
333–T7	940	8	500	4–6
355–T51	....	....	440	7–9
355–T6	980	8	310	3–5
355–T62	980	8	340	14–18
355–T71	980	8	475	4–6
356–T6	1000	8	310	3–5
356–T7	1000	8	440	7–9

①The solution heat treatment is followed by quenching in water at 150 to 212° F. except for 142-T77 sand castings, which are quenched in still air. A boiling water quench is recommended, since it minimizes quenching stresses and distortion.
②Nominal metal temperature should be maintained with as little variation as possible during the recommended time at temperature. Furnaces capable of maintaining the temperature well within plus or minus 10° F. of that desired are readily available.
③The exact time required is influenced by foundry variables and may have to be adjusted, from experience, to secure the typical properties for the alloy and temper.

precipitation at room temperature is relatively slow in most commercial aluminum casting alloys, but the rate varies with alloy composition. With increasing temperature, precipitation is progressively accelerated.

The structural changes involved in precipitation alter the mechanical and some of the physical properties of the alloy. A typical course of precipitation at a specific temperature involves a relatively rapid increase in hardness to a maximum, followed by a decrease at a moderate rate, and then further decrease at a progressively reducing rate for an extended period of time. In general, the tensile and yield strengths vary directly and the elongation inversely with hardness.

Maximum hardness is obtained by heating for long periods of time at slightly elevated temperatures. The specific time and temperature necessary for maximum hardness usually vary with alloy composition. At higher precipitation temperatures, the heating time required to attain "peak" hardness decreases with increases in temperature. However, "peak" hardness values become progressively lower as the precipitation treatment temperature is increased.

In the initial stage, the precipitate formed is too fine for resolution under a microscope. Its presence is inferred from indirect evidence such as change in mechanical properties and etching characteristics. The particles coalesce as the time or temperature is increased, a comparatively small increase in temperature being much more effective than a large increase in time. A treatment that has coalesced the precipitate into particles large enough to be visible under the microscope usually has carried the material beyond "peak" hardness.

Artificial Aging Treatments—In production terminology, precipitation hardening treatments are known as aging treatments and are further referred to as room temperature aging or artificial aging, depending upon whether they are carried out at room temperature or elevated temperature. Reference was made previously to the three types of artificial aging treatments that are of commercial importance for aluminum casting alloys.

Artificial aging only may be applied to castings in the "as-cast" condition. These treatments are effective because, as previously mentioned, most castings cool rapidly enough in production to retain a considerable degree of supersaturation of solid solution at room temperature. Low temperature artificial aging treatments of this type increase the tensile and yield strengths and the hardness, with some sacrifice in elongation. These changes in mechanical properties afford an improvement in machining characteristics.

Aging treatments at intermediate temperatures also may be applied to "as-cast" castings that are to be operated at elevated temperatures and in which even small permanent dimensional changes would be objectionable. Density changes usually accompany structure alterations involved in precipitation. The magnitude of these density or dimensional changes, which varies with alloy composition, is not great but must be taken into consideration in some casting applications. Use of such aging treatments causes growth to occur in the castings and, consequently, prevents permanent dimensional change later during operation at elevated temperatures.

A second type of aging treatment is the low temperature treatment used after a solution heat

(Continued on page 34)

CONVEYORIZED HARDENING FURNACES

Close Metallurgical control and savings in labor costs Effected with mechanized equipment

By **A. J. JAREMA**
Sales and Development Engineer
Lindberg Engineering Company
Chicago, Illinois

Modern conveyorized hardening furnace equipment can generally be guaranteed to offer the following advantages:

1. Hardening with the complete elimination of scaling and decarburization.
2. Reduction in amount of furnace operating labor. Less skilled labor may at times be employed provided close supervision is maintained.
3. Complete uniformity of physicals on both short and long-run jobs.

A well engineered modern belt conveyor hardening furnace coupled with a precision, fully automatic endothermic atmosphere generator will guarantee atmosphere control with complete elimination of scaling and decarburization. While this article deals principally with neutral hardening in electrically heated units, it should be mentioned that gas fired radiant tube heating also opens the field to carbon correction and addition as well as straight neutral hardening.

A single furnace operator can usually quite readily manage a harden-quench-draw installation capable of delivering up to 1800 lbs. of work per hour. With the conveyor type hardening furnace, once the work has been manually charged, it is not again handled until after it has quenched out and been carried from the quench tank by the flight conveyor. Upon discharging from the quench tank, the work may be permitted to drop directly into cylindrical baskets for subsequent tempering in forced convection pit furnaces. Fig. 1 shows a typical installation of this type. If complete mechanization is desired, the quench conveyor can be arranged to drop directly onto the belt of a conveyorized washer (if washing is required) or else directly onto the belt of a conveyorized draw furnace. Complete conveyorized hardening, quench, wash, and draw installations are common wherein the work is not manually handled from start to finish. These installations are very flexible and have been arranged in-line, L-shaped, and U-shaped.

Fig. 1—Typical installation of a conveyorized hardening furnace with a flight conveyor discharging work into baskets for tempering in pit-type furnaces at right.

Once the controlling pyrometers have been set and the variable speed belt drive adjusted for cycle, the conveyor hardening furnace guarantees 100% consistency of heat treatment hour after hour. On high-volume repetitive work, pyrometer set points and variable speed belt drive settings may be preestablished by plant engineering or metallurgical

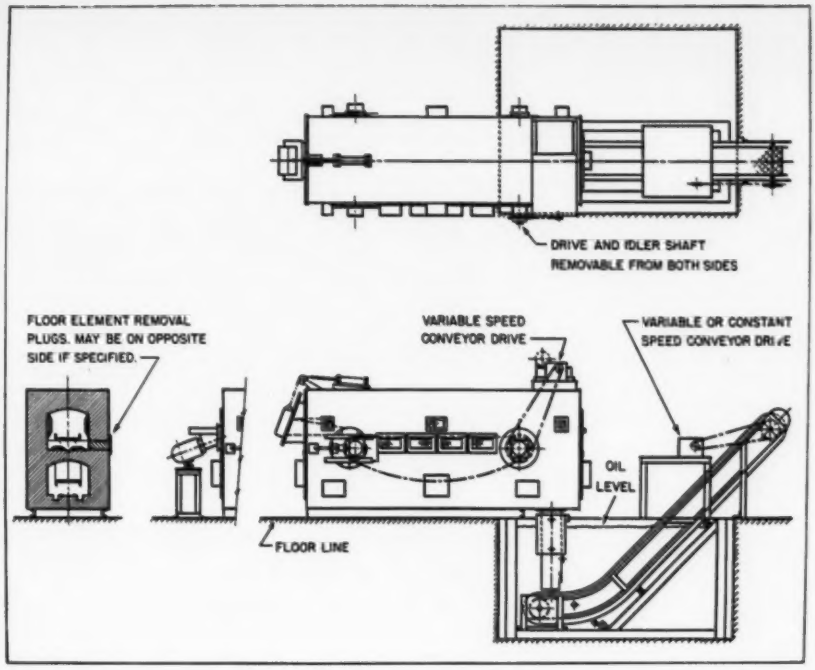


Fig. 2—A sketch showing conveyorized furnace with alternate magnetic feeder and flight conveyor quench tank.

control departments and passed on to the furnace operator in written form.

Typical parts which have been hardened with complete success in the conveyor type furnace are: socket wrench sockets and drive handles, bolts, nuts, and machine screws, pipe wrench jaws, military tank treads, hand plier forgings, auto body bumping hammers and dolly blocks.

Fig. 2 shows the general external appearance of a conveyorized hardening furnace. It will be noted that the furnace incorporates a completely enclosed belt with hot return and that the quench chute extends up into the furnace interior.

Furnace belts most frequently used are of the cast link type, 35-15 nickel-chrome alloy, 3" pitch. Links are laced together with ½" diameter wrought alloy cross rods and the outer rows of links are provided with integral 3" interlocking sideguards to prevent work from falling from the belt.

Several types of belt take-ups have been used but the most recent and satisfactory is the combition catenary suspension with longitudinally adjustable front, or idler, drum, as shown in Fig. 3. The longitudinal drum adjustment serves as the "rough" adjustment to compensate for belt growth, adding links, removing links, etc. The catenary lower strand provides the "fine" adjustment to automatically take care of thermal expansion and contraction, thereby eliminating excessive stresses on belt links and cross rods.

Belt drive is of the variable speed type. Drives can be fitted with indicating tachometers calibrated to read directly in feet per minute or feet per hour. Another interesting ramification has been the use of a radiation type temperature sensing element placed in the furnace arch and sighting directly on the work just ahead of the quench chute. The pyrometer is tied in through a relay to the drive motor starter to instantly stop the belt at any time if work temperature should fall below the discharge zone pyrometer set point. With this arrangement, the furnace may be pushed to the very maximum production limit with no danger of even an occasional piece being quenched below temperature.

The internal furnace quench chute is of cast alloy and catches the work as it drops from the conveyor belt. An external steel extension is provided on the quench chute of sufficient length to terminate below the quench liquid level, thus assuring an effective atmosphere seal at this point. This external quench chute is fitted with a water cooled jacket to condense as much as possible of any oil fumes or water vapor that originate in the quench. A 1/3 HP exhauster is also provided.

(Continued on page 30)

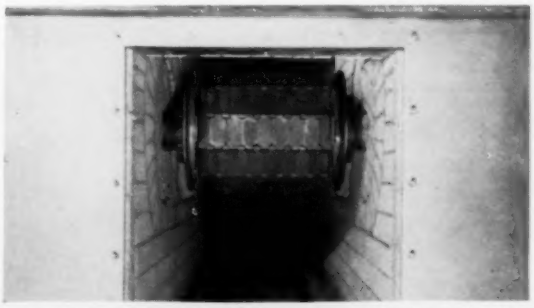


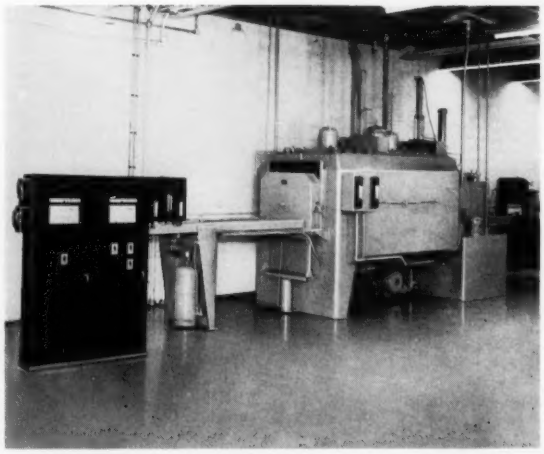
Fig. 3—View of furnace with front plug removed showing idler drum, cast link belt and catenary suspension of return strand.

Pusher-Chain Conveyor Combined In SEMI-CONTINUOUS PRODUCTION UNIT

By **H. N. IPSEN**
President, Ipsen Industries, Inc.
Rockford, Illinois

Ipsen Industries, Inc., one of the pioneers in the development of the automatic controlled atmosphere batch type furnace for bright, scale free heat treating, has now designed into a high production furnace the basic principles which have made the batch type furnace so popular. Essentially, this equipment is of the same basic design as other smaller Ipsen units except that it is built as a semi-continuous type furnace. The modern furnace should be considered a heat treating tool in which, through control of the many variables of heat treating such as temperature, rate of heating, time, atmosphere and quenching, combined with close metallurgical supervision, work can be consistently duplicated the same as on modern production machine tools.

Today's stiff competition necessitates high quality work where rejects, distortion, breakage and rework must be kept to the minimum. This has brought about continuous research in furnace design and heat treating techniques to apply the basic principles incorporated in the smaller automatic, controlled atmosphere, batch type furnace into a semi-continuous, automatic, controlled atmosphere furnace to meet demands of increased production. Versatility has been designed into this unit so that changes in design of company products can be handled easily.

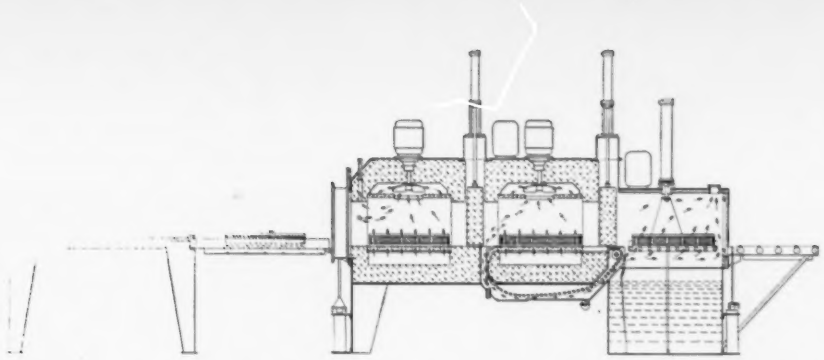


An overall view of this semi-continuous unit installed with temperature and atmosphere control panels. Rated capacity is 800 lbs. per hour.

Automatic Loading With Straight Through Operation

Due to the wide acceptability of straight through operation in the smaller units, this has been incorporated into the larger units which are also equipped with an automatic loading device. After considerable investigation, an 800 lb./hr. unit was found to be the most practical size for the application of the basic design into semi-continuous operation. The T-800 furnace is now a packaged unit incorporating enclosed quench, heating chambers, loader and control panels, allowing complete assembly at the factory.

Several engineering features are worthy of note and differ from other furnaces of this type. The T-800 unit employs two separate heat chambers, which are independently controlled and separated by an inner door. This permits excellent atmosphere control, since it prevents temperature differences from one section of the furnace to another. The temperature is maintained uniformly in each chamber and does not vary from cold at the loading end to hot at the discharge end. This prevents sooting and scaling of the work when being heated to temperature, and also prevents excess contamination of the work being held at heat when the work load is charged into the furnace.



This schematic diagram shows the movement of the work through the furnace. The pusher mechanism at left moves work from the first to the second zone and loads a new batch into the first zone. Work is transferred from the second zone into the cooling zone by a "cold" chain drive. An airdraulic cylinder lowers work into the quench.

The unit is heated by forced convection, the heat source consisting of non-alloy radiant tubes. This assures high efficiency in heating and uniformity of temperature. The radiant tubes, made of a ceramic material, are not subject to carburization, warpage or hot spots. The fan which circulates the atmosphere for both heating and atmosphere control is an integral part of the motor. Water-jacketed bearings and a low starting torque assure long fan motor life. A pre-heating unit for this furnace is also available which increases the output to approximately 1200 lb./hr.

Air Tight Doors Complete Atmosphere Seal

It is generally known that air contamination or pickup in the quenching oil affects the ultimate brightness of the work. Any oil surface exposed to the air will entrap varying amounts of oxygen, especially under conditions of agitation. Discoloration of work from this source would be especially pronounced on heavier sections, due to slower cooling rates. This is overcome in the design of this unit by employing spring-loaded, air-tight doors which act as a complete atmosphere seal throughout the unit.

A novel transfer mechanism is employed for loading and transferring the work basket in the heating and quench chambers. The automatic loader, when activated, loads the first chamber and also transfers the work basket from the first into the second chamber. The pusher rods, transferring the work baskets, are then completely withdrawn from the furnace. The work basket is transferred from the second heating chamber into the quench tank by two alloy chains which will traverse one-half revolution before the dogs, used in moving the work load, engage it. This allows the work to be transferred with relatively cold chain which has been below the hearth of the furnace. This cold chain system along with the removal of the transfer and loading pusher rods, which are kept out of the hot zone of the furnace except when in actual operation, greatly reduces maintenance cost on these parts.

The cooling chamber above the quench tank is completely waterjacketed with an aquastat control to maintain it at the desired temperature. The quench tank temperature is regulated by the circulation of water through a series of finned coils. For special applications, heaters can be installed and the tank insulated for modified martempering applications. The three degrees of agitation available for the oil include still oil, moderate flow and high flow. This enables the operator to pre-select at the control panel the degree of agitation required for maximum hardness and minimum distortion.

Operation of the furnace is regulated at the control panels. The controls consist of two temperature control instruments, one for each heating chamber, and automatic cycling controls for the quench circulation. Control of the atmosphere is done at the atmosphere control panel which consists of three flow scopes, one for carrier gas, one for ammonia additions, and one for carburizing gas additions. The atmosphere is easily changed from one type to another by simple adjustments of the flow scopes.

Simplicity and Flexibility Increase Efficiency

Aided by the push button time cycle, quench cycle control, and indicating signal lights, together with the automatic transfer and quench of a charge, the operation of the furnace is reduced to a simple loading and unloading detail. Thus, furnace operators can be quickly trained to handle the equipment.

This unit, having the basic design of the successful batch type controlled atmosphere furnace incorporated in it, has brought to the heat treater a furnace for heavy production runs, one with a considerable degree of versatility and one which offers complete atmosphere control, automatic cycling and controlled quenching. ■ ■ ■

In Case You Missed It— Here's a ***METAL SHOW REVIEW***

The National Metal Exposition held at Cleveland, Ohio this year was the largest in history. 45,000 people registered to see demonstrations of the products of 462 exhibitors in the show. Some of the equipment on display is reviewed here— after this report by The "Old Timer" . . .

The Big Show in Cleveland attracted the usual throng of enthusiastic Metal Men and followed the customary routine of exceeding all previous occasions in size, splendor and complexity. The program of technical papers and lectures alone was a monument to the energy, industry and endurance of the metallurgical profession. The exposition was truly colossal.

Aside from the traditional difficulty of finding sleeping accommodations for the great throng of visitors in Cleveland—many of whom were shipped to outlying "suburbs" such as Akron—the old timer is tempted to wonder whether the virtue of bigness may not have reached a limit. After all, the real customers for this event are the loyal members of ASM whose attendance provides the market for exhibitors and the audience for speakers.

There's a cogent warning for lecturers: —"The human mind cannot absorb more than the backside can endure," which might be extended further down the anatomy to include the pedal extremities. Metal Shows exhaust the feet and, by reaction, the brain.

The Management's concern with the danger of exceeding the endurance limit even of steel men, was evident from the provision of the now celebrated Eisenman downy red carpet, the installation of numerous coffee counters throughout the exhibition hall and the introduction of a waker-up free coffee session in the midst of heavy technical programs.

Even with gratitude for these blessings, one gathered the impression from many personal contacts that it was all just a little too much and why not begin to concentrate on quality, technical interest, progress and new developments, rather than mere size?

Of course, the Metal Show is a great Annual Event and revenue from exhibition space is one of the leading financial factors in permitting ASM service to its members to far exceed the income from dues.

But many of the exhibits are merely show windows for the display of goods that have long ago lost novelty, or whose connection with the metal industry is somewhat incidental. A smaller show, more compact, arranged by subjects for the convenience of those interested in a particular field, with wider aisle space to avoid congestion, and perhaps with one-way traffic to reduce jams, would be a relief.

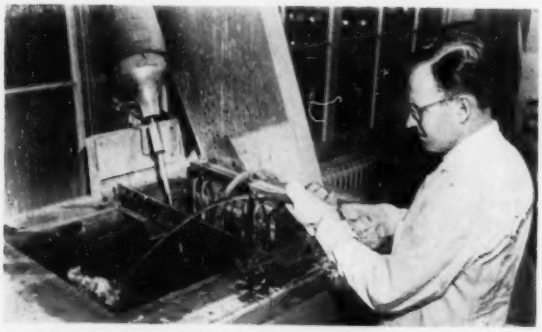
It has even been suggested that a new show devoted exclusively to the field of heat treatment of metals is a possibility.

Censorship of exhibits, designed to mitigate the "lures of sex," complained of at Philadelphia last year, was in operation. Low-neck fronts were eliminated, or let us say elevated. The fevered male mind was permitted to concentrate on heat resisting alloys, high temperature pyrometers and low temperature welding rods. Perhaps it was all for the best, because some people never know where to draw the line. But lots of pulchritude was present anyway, providing an occasional refresher for the weary eye, and some well-bred amusement. In this category we wish to compliment Westinghouse for an attractive and clever demonstration and demonstrator, which put life and interest into an otherwise static exhibit. Let's have more of this.

"Old Timer"

.. Heat Treating Highlights of the Show

Salt Bath Operation Improved By Water Addition



A simple method of sharply improving both the quenching and tempering action of salt baths, without cost, was demonstrated publicly for the first time by American Cyanamid Company, New York, N. Y., supplier of salt baths, steel additives and other chemicals to the metal industry.

Water was added to a nitrate-nitrite bath while in a molten state. This, according to E. N. Case, Supervisor of Cyanamid's Metals Chemicals Group, results in the following advantages: (a) It will operate at temperatures lower than 275°F, while other baths are limited to 300°F; (b) The bath maintains its original composition for long periods of time below the mixture's boiling point; (c) Martempering and hot-quenching operations take place at greatly accelerated quenching rates; (d) Specific degrees of hardening may be obtained by altering the amount of water in the bath, a unique characteristic since the controlling factor is the bath composition rather than the alloy content of the steel; (e) The bath can be easily restored to the more conventional type by raising its temperature to eliminate the water.

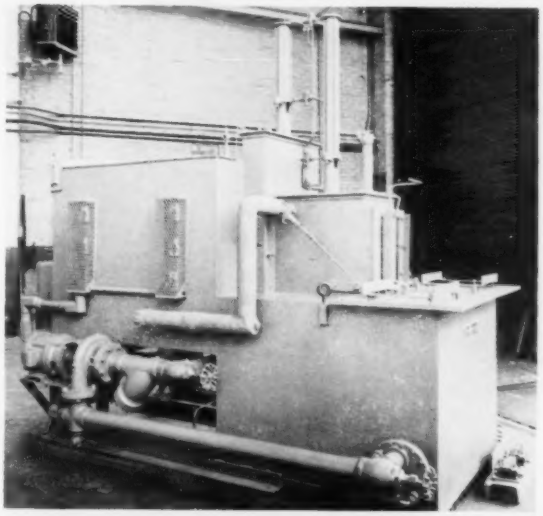
Water can be added without violent splattering if the bath is agitated and below 350°F, despite the fact that this is more than 100°F above the temperature at which water turns to steam. The nitrate molecules, Mr. Case explained, have such an affinity for water molecules that they become bonded before the water reaches the boiling point.

The development represents an unusual exception to a widespread safety practice in the metals industry, which calls for water always to be kept away from molten salt baths.

Horizontal Homocarb Furnace With Protected Quench

A new Homocarb furnace with protected quench was demonstrated by the Leeds & Northrup Company, Philadelphia, Pa. The equipment consisted of a horizontal Homocarb furnace with Microcarb atmosphere control and L & N temperature control.

This new unit combines a heating chamber, quench tank and protective atmosphere vestibule. The Homo principle of forced convection is used to assure uniform circulation in both the heating chamber and quench. In the heating chamber a high pressure fan circulates heat and atmosphere uniformly through the load. In the quench a large motor-driven pump circulates oil down through the load. Between heating and quenching, the work is protected in a sealed vestibule under the controlled atmosphere generated in the heating chamber. From the time a load enters the furnace until the quench is completed it is never exposed to air.



Three years ago Microcarb atmosphere control was introduced by L&N for use with pit-type Homocarb furnaces. The detecting element, a Carbohm, is located in the work chamber where it is exposed to the same conditions as the load.

The combination of controlled temperature, controlled atmosphere, forced circulation and protected quench provides an efficient unit for production heat treating. The equipment can be used between temperatures of 1500 to 1750°F, and throughout a carbon range of 0.15% to 1.15% C for hardening, carburizing, homogeneous carburizing or carbon restoration.

Heat Treating Facilities

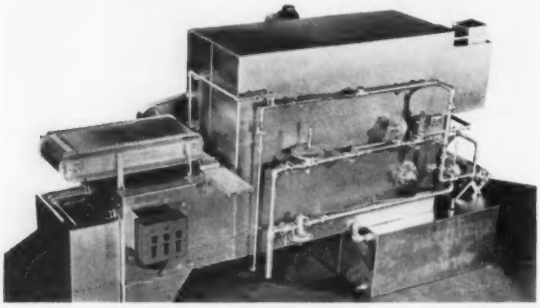
The main attraction of the exhibit of the Lakeside Steel Improvement Co., Cleveland 14, Ohio, at the Metal Show was a transparent, three-dimensional plastic scale model of their plant and offices.

This model was complete in every detail to show both the completeness of the Lakeside facilities

and the departmentalization of a modern commercial heat treating plant. Every model machine and furnace is a scale duplicate of Lakeside's actual equipment, arranged in exact position relative to the actual plant.

Another feature of the Lakeside booth was a scale operating model of the radial hardening machine which they have developed and patented. Specimens of actual heat treating jobs performed by Lakeside completed this exhibit.

Semi-Continuous Unit For Clean Hardening

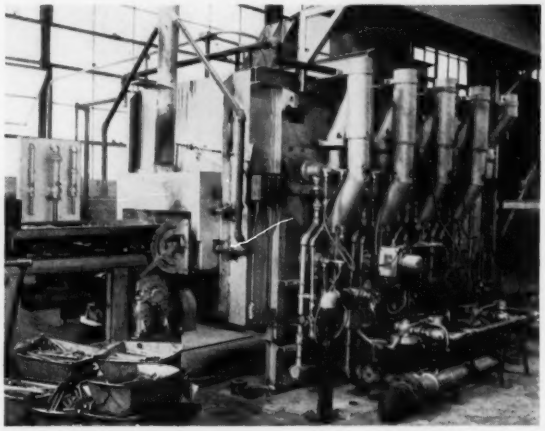


The Industrial Heating Equipment Company of Detroit, Mich., displayed a semi-continuous conveyorized unit for clean hardening with a capacity rated at 150 lbs. per hour. The radiant tube gas-fired unit includes a built-in generator, quench tank, loading conveyor and quench conveyor. The loading conveyor and the furnace conveyor are integrally driven while a separate drive is provided for the quench conveyor. The unit was designed as a "package" for the handling of small parts. Overall dimensions are 16' 6" long x 5' 10" wide x 7' 5" high. The effective work area is 5' long on a 1' 6" wide belt.

Shaker Hearth Furnace

The shaker hearth furnace shown here in operation was displayed by Westinghouse Electric Corp., Pittsburgh 30, Pa. It was designed for hardening small, light weight parts in an Endogas atmosphere up to 1700°F. Rated production at 1600°F is 400 to 600 lbs. per hour.

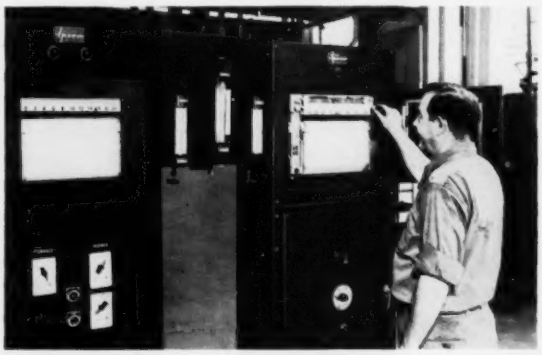
The shaker mechanism is mounted separately so that the furnace does not receive any of the shock from oscillation of the hearth. The work area of the hardening zone is 30" wide x 84" long x 3" high. Radiant tubes are installed under and over the shaker hearth and are fired from the same side of the furnace. The furnace is also available with electric heating elements, if desired.



A quench tank and conveyor complete the unit. Typical applications include the hardening of pocket knife blades, small flat springs, screws, bolts and other small hardware. Parts which are round or which will roll en masse are not suitably conveyed by the shaker hearth.

Dew Point Recording Controller

Ipsen Industries, Inc., Rockford, Ill., displayed their new automatic dew point controller which electronically controls and records furnace atmosphere dew point for automatic cycling of carburizing and carbon restoration treatments. The unit is



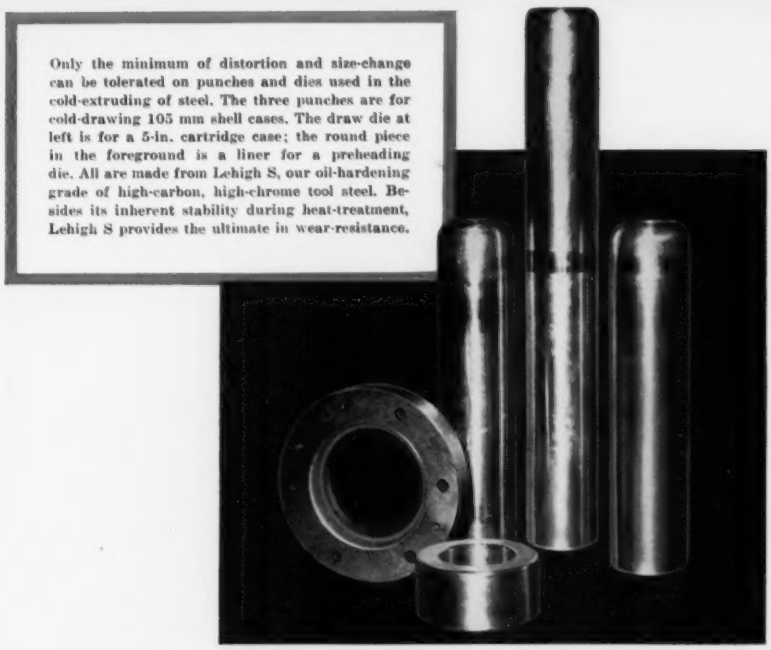
adjustable to meet any desired dew point within the capacity of the particular furnace to which it is attached. Furnace atmosphere is pumped through a 5/16" steel tube where it is cooled and

(*Continued on page* 24)

Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation



Only the minimum of distortion and size-change can be tolerated on punches and dies used in the cold-extruding of steel. The three punches are for cold-drawing 105 mm shell cases. The draw die at left is for a 5-in. cartridge case; the round piece in the foreground is a liner for a preheading die. All are made from Lehigh S, our oil-hardening grade of high-carbon, high-chrome tool steel. Besides its inherent stability during heat-treatment, Lehigh S provides the ultimate in wear-resistance.

There's no such thing as a non-deforming tool steel

Shrinkage, growth, and warpage—all occur when a tool is heated for hardening. There just isn't a tool steel which is "non-deforming" in the absolute sense of the term.

It's downright discouraging when an accurately machined tool or die emerges from the heat-treating furnace with its shape distorted or its dimensions way beyond the allowable tolerances. Yet, this experience is quite common.

In many instances the change in size caused by heat-treatment is not so great as to cause any trouble. Proper grinding, to remove scale and to obtain exact tool dimensions, is often all that is necessary. However, excessive warpage or size change can make it costly, even impossible, to restore a tool to the proper shape or correct dimensions, either by grinding or by corrective heat-treatment.

It's obviously important for both toolmakers and heat-treaters to understand the causes of distortion and how it can be controlled within reasonable limits. The design of tools, the grade of tool steel used, and heat-treatment procedures—all these factors have a bearing on the degree of distortion which will occur.

Warpage, for example, is usually a factor associated with the geometrical shape of a tool and with the thermal stresses produced by lack of uniformity in heating or cooling operations. The composition of a tool steel has very little to do with the occurrence of warpage.

On the other hand, the growth or shrinkage of tools is the result of volume changes caused by the hardening operation. Each grade of steel has certain characteristics of inherent distortion. And it varies considerably with the composition. Carbon tool steel, for example, has a distortion "factor" of approximately .002 to .004 in. on the plus side. A high-carbon, high-chromium grade, such as our Lehigh H, has a factor of only .0005 in., plus or minus.

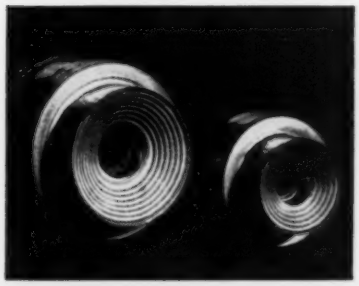
If you'd like a printed discussion of this subject write to our Publications Dept. at Bethlehem, Pa., for the booklet "Distortion of Tool Steels in Heat Treatment."

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Avoid drastic changes of section in tool design

You can expect trouble whenever a tool made of a liquid-quenched steel is designed so that heavy and light sections are adjacent. When such a tool is quenched, the light sections cool rapidly and harden before the adjacent heavy sections. Quenching stresses are set up which often exceed the strength of the steel. Cracking is the result.

Although such tools fail during heat-treatment, poor tool design must take the blame. Troubles of this sort are sometimes avoided by differential hardening or making this type of tool as a two-piece assembly. But if a one-piece construction is necessary, then it's best to use an air-hardening steel.



FOR TOOTHPASTE TUBES

These intricately machined dies are used in shaping the tapered neck and tip of toothpaste tubes which are extruded from round slugs of aluminum. When a punch is driven downward towards the die, the aluminum "biscuit" is trapped between the punch tip and the die and is extruded by the heavy pressure, flowing upwards along the cylindrical punch to form the tube body.

The dies pictured are made from our 67 Chisel tool steel, a chrome-tungsten grade of shock-resisting steel that's ideal for tools and dies requiring plenty of impact strength. Although it is principally a shock type of steel, 67 Chisel is readily carburized whenever extra wear-resistance is needed . . . without sacrificing the advantages of its tough core.

Easy to machine and heat-treat, 67 Chisel is stocked by distributors of Bethlehem tool steel in principal cities.

News to Heat Treaters...

American Ordnance Association Thirty-Fifth Annual Meeting

Approximately 10,000 people were in attendance at the Annual Meeting of the American Ordnance Association on October 8th at Aberdeen Proving Ground, Maryland. Special trains were provided to carry spectators directly to the grand stands where they witnessed demonstrations of arms and equipment from small arms such as the .45 caliber sub-machine gun to the giant 280 mm "atomic" cannon.

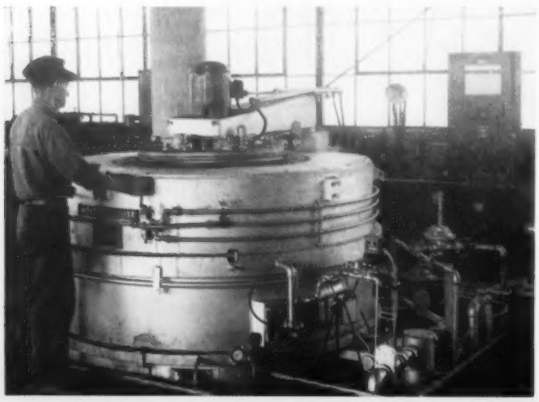
This one-day meeting was organized to show members of the Association examples of the latest developments in ordnance. Those present heard General Matthew B. Ridgeway give an address in which he stressed the importance of each division of a successful military establishment—arms and equipment, training and morale, supervision and leadership.

Among those in attendance were representatives from Pittsburgh Commercial Heat Treating Company, J. W. Rex Company, Benedict-Miller, Inc., and Metlab Company. It was interesting to note that a high percentage of the items demonstrated were heat treated by these Metal Treating Institute members.

Gas-Fired Pit Furnace

A gas-fired, pit furnace for cycle annealing of small parts is now available from the Westinghouse Electric Corporation, Box 2099, Pittsburgh 30, Pa. The furnace can also be used for carburizing, hardening and nitriding.

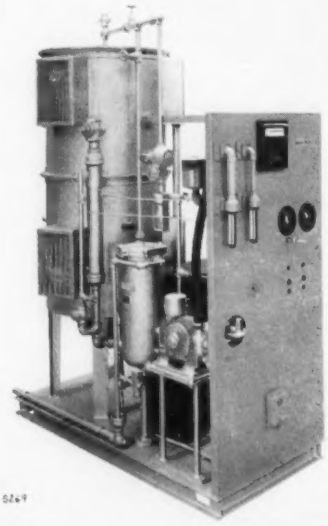
A removable retort makes continuous operation possible since one retort can be discharged and recharged while the other is in the furnace. Maximum operating temperature is 1600 degrees F. The hydraulically-operated furnace cover is suspended from a pivoted arm so it can be easily pushed to either side when raised.



The firing of this furnace is completely automatic and a combustion blower system is contained for purging and cooling purposes. In addition, instruments for turning off the gas supply in the event of flame failure and for shutting off the gas in case of low pressure are provided.

The furnace is available in five sizes ranging from a charge space of 14 inches in diameter by 18 inches deep with an approximate production rate of 120 pounds per hour net to 30 inches diameter by 72 inches deep with an approximate production rate of 2100 pounds per hour net.

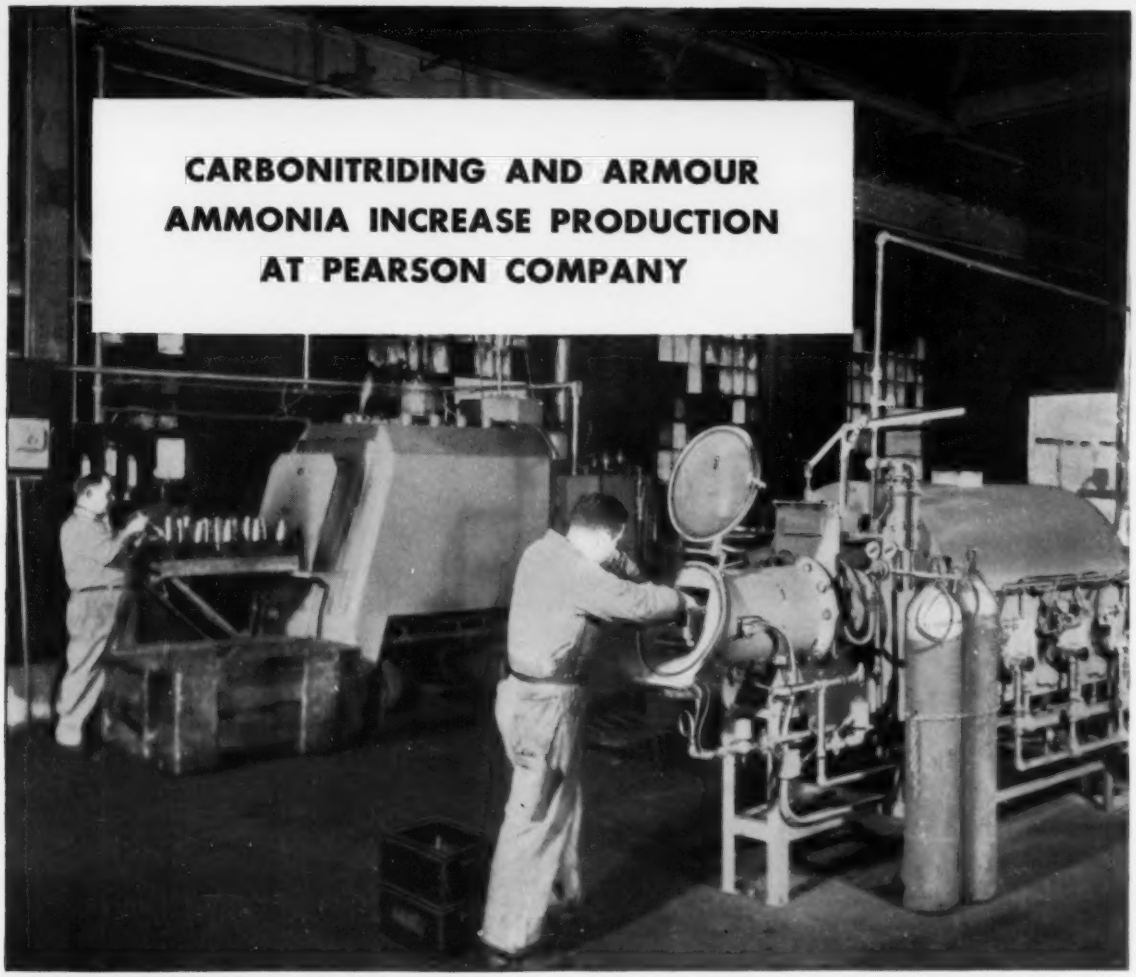
Endothermic Gas Generator



An endothermic gas generator which has been in test operation in production plants for over two years is available from Hevi Duty Electric Co., Milwaukee 1, Wis. All the latest features are included in this design to assure trouble free generator operation.

The generator will produce controlled atmos-

(*Continued on page* 16)



CARBONITRIDING AND ARMOUR AMMONIA INCREASE PRODUCTION AT PEARSON COMPANY

New processes prove more efficient, safer for metal treating

Those carbonitriding and brazing furnaces above mean greater production and safety at the Pearson Industrial Steel Treating Company in Chicago. And Pearson specifies Armour's pure, dry ammonia and dependable service for their carbonitriding.

All through the metal treating field, plants are using every improved process they can to provide their clients with better work. Since many of these new processes require ammonia, more and more companies like Pearson are calling on Armour ammonia and service for best results.

Carbonitriding has reduced costs and increased safety in many plants. And Armour men were there in many cases to give advice and help on installations. Those men in Armour's Technical Service Department are equipped and ready to help you in your installation.

Since 1947 Armour has sponsored a fellowship at the Massachusetts Institute of Technology for the study of carbonitriding and other modern metal treating processes. That knowledge is basic research, and available to you.

The booklets offered at right will show you how to put this knowledge to work in your plant. Write today for free copies. If your ammonia problem is unusual or pressing, write us today giving full details of your requirements.

Clip and mail this today!

☐ "Applications of Dissociated Ammonia"
☐ "Ammonia Installations for Metal Treating"
☐ "The Nitriding Process" ☐ "Carbonitriding"

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phere of consistent chemical analysis for heat treating operations such as bright hardening of high carbon steels without oxidation or decarburization; bright hardening of molybdenum, tungsten, and cobalt high-speed steel; annealing and normalizing; bright copper brazing, carburizing and carbonitriding; sintering and powder metallurgy processes that require a reducing atmosphere.

The Hevi Duty generator is a complete package unit. The air filter, air gas mixing machine, gas cracking chamber, gas cooler, control panel, and power transformer are all mounted on a structural steel base. The generator has been designed for economical, safe, and simple operation.

Available in three sizes (300, 500, 750 cubic feet per hour) the Hevi Duty generator is of functional design with easily removable parts which simplify inspection and maintenance.

New Furnace Loader

Michigan Crane and Conveyor Co., 115 McKinstry St., Detroit, Mich., has a new device called Man-O-Steel, a heat treat furnace loader which automatically removes material from a hopper and discharges it in even and metered quantities into an endless belt type heat treat furnace.

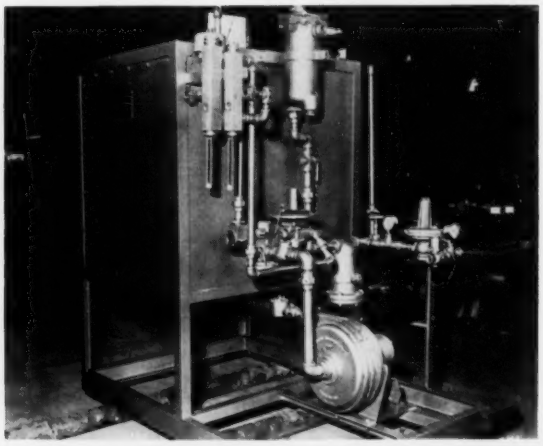
The basic mechanism is a series of synchronized vertical-moving pushers, cut on a 30 degree angle. The submerged pushers remove parts from the hopper, raising them to the next level and causing them to roll off by the force of gravity. The material continues to be elevated and transferred in this way through a series of cycles until discharged into the furnace.

With this piece of equipment one man can load from 500 to 4,000 pounds per hour of small stampings, forgings or castings to the full capacity of the furnace for an indefinite run.

Installations already in use prove that by eliminating one or more workers, this loader reduces production cost and minimizes the human element of error and job fatigue. Custom made to fit specified space requirements, the average dimension of the loader is 10′ high by 8′ long. It is of steel construction, complete with drive, variable speed controls, overload safety clutch, reversing starters and push button controls.

Atmosphere Generator

A new endothermic type protective atmosphere generator for protecting metals during heat treatment is available from Ferguson Equipment Corp., 21st St. & Penn Ave., Pittsburgh, Pa. The range of sizes available is from 250 to 3000 cubic feet per hour output.



The generator features a rectangular alloy retort in the smaller sizes and centrifugally cast alloy retorts in the larger sizes. It is electrically heated by means of radiant tube type elements that can be readily changed without interrupting operation of the generator. Provisions are made for admission of enriching gasses for extra brightness of special work.

R-S Furnace Organization Incorporated

The furnace division of R-S Products Corporation has announced its incorporation, and will be known in the future as R-S Furnace Corporation,

(*Continued on page* 18)

eliminate the guesswork in selecting tool steels

Thousands of metal working people are using the Crucible Tool Steel Selector to determine exactly which type of steel they need. This handy selector covers 22 tool steels which fit 98% of all tool steel applications.

The selector is unique because it starts with the ultimate use of the steel. It breaks down all tool steel applications into six major classifications, under which the different grades of steel available for certain specific requirements are indicated in legible cutouts. Heat treatment and machinability data are also included for each grade.

A flip of the dial will give you the answer, and almost just as quickly you can get the steel you select. For each type of steel shown on the selector is in stock in Crucible warehouses, conveniently located throughout the country.

To get your Selector merely fill in the coupon and mail. There is no obligation whatsoever.

⅓ actual size, Selector is in 3 colors

HERE'S AN EXAMPLE:

Application — Deep drawing die for steel

Major Class — Metal Forming — Cold

Sub-Group — Special Purpose

Tool Characteristics — Wear Resistance

Tool Steel — Airdi 150

A turn of the dial does it! And you're sure you're right

Crucible Steel Company of America
Dept. MT, Oliver Building,
Pittsburgh 22, Pa.

Name_____

Company_____ Title_____

Address_____ City_____ State_____

CRUCIBLE first name in special purpose steels

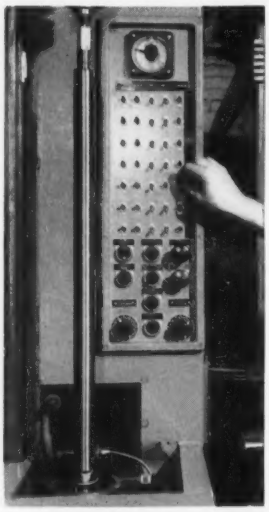
53 years of Fine steelmaking **TOOL STEELS**

CRUCIBLE STEEL COMPANY OF AMERICA · TOOL STEEL SALES · SYRACUSE, N. Y.

a subsidiary of Hardinge Company, Incorporated. The new corporation will maintain its sales and engineering offices at the same address as formerly —4555 Germantown Avenue, Philadelphia 44, Pennsylvania. Personnel will remain unchanged. D. E. Wyman will continue in the capacity of vice president; S. M. Stoler as assistant to the vice president; and F. L. Feldmeth as chief engineer.

R-S Furnaces are custom-built and field-erected for billet-heating, forging and heat treating of steel and non-ferrous materials.

Induction Heater Speeds Production at New England Machinery Company



Hardening of textile machinery parts has been stepped-up more than 1000 percent at the Whitin Machine Works in Whitinsville, Mass., through the use of a General Electric 50-kw electronic induction heater. According to Whitin engineers, the heater hardens bottom twister rolls at the rate of 35 an hour. Formerly the job was done by a cyanide furnace which took three and a half hours to harden eleven pieces.

The unit shown hardens various sized rolls up to almost 40 inches in length. Heat is applied where needed, and the controls on the front of the panel adjust the cycle for the particular roll being hardened.

On the heater table, next to the roll hardener, two positions are employed. While one piece is going through the hardening cycle, another part is set up on the other side. A transfer switch permits changing the heat from the first to the second coil, and while the new piece is being hardened, the first position is set up again.

The 50-kw heater, and three 20-kw units also at Whitin, handle more than five hundred different parts. Mainly used for hardening, they also do annealing, silver soldering, and soft soldering.

Collodial Graphite for Bearings

Frozen bearings in the wheels of overhead oven conveyor trolleys caused continuous trouble at Simmons Company, Elizabeth, N. J., manufacturers of world-renowned mattresses. The bearing retainers roll into tempering ovens operating at 600°F. and paint-baking ovens at 300°F. Many lubricants tended to decompose or burn-off at these

temperatures, but 'Oildag,' a dispersion of colloidal graphite in oil unaffected by the temperatures required, proved successful.

As shown operators push the "Deep Sleep" box springs, attached to the trolleys, into the oven for oil burn-off and spring tempering. The spring assemblies are then removed from the oven, dipped in paint and returned to it for 15 minutes at 300°F.

New Use For Salt Bath

The "Aldip" process for aluminizing iron and steel was displayed publicly for the first time at the Metal Show by Ajax Electric Company, Phila. 23, Pa. Developed by General Motors, the process is a unique method of aluminizing finished parts with relatively inexpensive equipment and simple procedures. Shown in the photo is an Ajax-Hultgren salt bath furnace which was used for the demonstration. The bath contains a layer of aluminum on the bottom with a layer of salt floating above it. Parts are dipped into the salt, held until heated through, and then lowered into the aluminum. The resulting coating is uniform, dense and permanently adherent. Cleaning and degreasing is required prior to dipping. ■ ■ ■

Here you see a long life Incoloy hydrogen annealing retort going into the furnace at L. & R.'s shop where it will soak at 2050° F. for 4 hours, then be gradually cooled to room temperature. It was fabricated by the NEWARK METAL PRODUCTS CO., Kenilworth, N. J., from 1100 pounds of Incoloy.

56-Hour Work Week a Year

... Incoloy retort still going strong at temperatures up to 2050°

Latest reports on Incoloy®, new companion alloy to Inconel®, include some remarkable service records.

As a hydrogen annealing retort, for instance.

Here — where other metals failed quickly, some in as little as 42 hours — Incoloy has already given over 3,000 hours of service. And it's still going strong.

This Incoloy annealing retort is being used by L. & R. HEAT TREATING COMPANY in Newark, N. J., for heat treating T.V. shields, hearing aid components, and laminators for servo-motors.

What an ordeal this retort goes through!

First, after being loaded, the retort is soaked at 2050°F. for 4 hours. Then the temperature is reduced 100°F. hourly until the retort reaches 1200°F. It is held there an hour and then allowed to cool to room temperature. *A total heat of 14 hours.* And it has to go through this grind four times a week!

L. & R.'s Incoloy retort has been in service a year now and it's still in shape for more of the same.

Their engineers, still watching Incoloy's record, already say service has been "very satisfactory."

The fabricators of the Incoloy retort, NEWARK METAL PRODUCTS CO., Kenilworth, N. J., found that this new member of the Inco family was readily fabricated into heat treating equipment of all types. It is both workable and weldable for maximum flexibility in efficient design.

If you would like to learn more about Incoloy, write for your copy of "Preliminary Report on Incoloy."

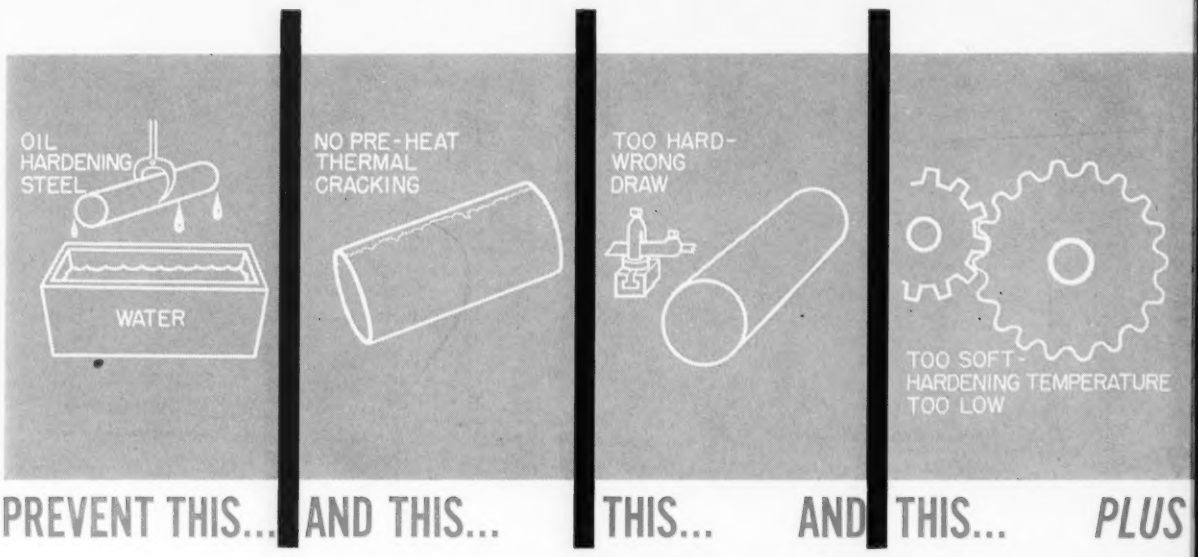
THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, New York

Inco Nickel Alloys

Incoloy... *for Heat-Resisting Applications*

A SURE WAY TO

in HEAT T



One of the most common causes of error in heat treatment is failure to give the heat treater necessary data on the physical properties and chemical composition of the material to be treated.

When parts do not respond to treatment as expected, further corrective treatment is often necessary thus wasting valuable time and hard earned money for both the customer and the heat treater. Or in extreme cases the part is actually rendered useless and becomes scrap.

Acceptance and use of the new SAE designations given to commonly used steels to show their *heat treating characteristics and reactivity* will do a great deal to eliminate costly error and uncertainty.

Use of the identifying codes will save further time for the customer and the heat treater since the standardization of the SAE designations will make many other specifications presently used unnecessary.

Copies of the SAE number assigned to various materials in accordance with their heat treatability can be obtained from your local MTI member or from the Metal Treating Institute.

Get a copy now and you will easily see how their use will *help you*.

REVENT ERRORS

EATMENT

There's a Heat Treating Specialist Near Your Plant!

ALABAMA

outhern Metal Treating Co., Inc.
3131 10th Ave., North, Birmingham 4

CALIFORNIA

lifornia-Doran Heat Treating Co.
2850 E. Washington Blvd., Los Angeles 23
ollywood Heat Treating Co.
1046 No. Orange Drive, Los Angeles 38
ndberg Steel Treating Co.
2910 S. Sunol Drive, Los Angeles 23
ook Induction Heating Co.
4925 East Slauson Ave., Maywood
exter Metal Treating Co.
1026—77th Ave., Oakland 21
dustrial Steel Treating Co.
1549—32nd St., Oakland 8
alley Metal Treating Co.
377 E. Commercial St., Pamona

COLORADO

letal Treating & Research Co.
4110 Fox St., Denver 16

CONNECTICUT

ommercial Metal Treating, Inc.
89 Island Brook Ave., Bridgeport 6
tanley P. Rockwell Co.
296 Homestead Ave., Hartford 5

ILLINOIS

enecca Heat Treating Co.
70 S. Batavia Ave., Batavia
ccurate Steel Treating Co.
2226 W. Hubbard St., Chicago 12
hicago Steel Treating Co.
333 North California, Chicago
ura-Hard Steel Treating Co.
2333 West Deming Place, Chicago 47
earson Industrial Steel Treating
5757 Ogden Ave., Chicago 50
erfection Tool & Metal Heat Treating Co.
1740 West Hubbard St., Chicago 22
red A. Snow Co.
1942 West Kenzie St., Chicago 22
merican Steel Treating Co.
P. O. Box A, Crystal Lake
klund Metal Treating, Inc.
721 Beacon St., Love Park
indberg Steel Treating Co.
1975 No. Ruby St., Melrose Park
. T. Muehlemeyer Heat Treating Co.
1531 Preston St., Rockford
. U. Scott & Son, Inc.
1510 First Ave., Rock Island

INDIANA

erl Heat Treat Corp.
1824 So. Franklin St., South Bend 23

MARYLAND

aryland Tool Company
111-13 Hollingsworth St., Baltimore 2

MASSACHUSETTS

New England Metallurgical Corp.
9 Alger St., South Boston 27
Porter Forge & Furnace, Inc.
74 Foley St., Somerville 43
Greenman Steel Treating Co.
284 Grove St., Worcester 5

MICHIGAN

Acme Steel Treating Co.
119 Lieb St., Detroit 7
Anderson Steel Treating Co.
1337 Maple St., Detroit 7
Bosworth Steel Treating Co.
18174 West Chicago Blvd., Detroit 28
Commercial Steel Treating Corp.
6100 Tireman Ave., Detroit 4
Commonwealth Industries, Inc.
5922 Commonwealth Ave., Detroit 8
Michigan Steel Processing Co.
3120 Denton, Detroit 11
Standard Steel Treating Co.
3468 Lovett Avenue, Detroit 10
Vincent Steel Process Co.
2424 Bellevue Ave., Detroit 7
State Heat Treat, Inc.
520 32nd Street, S. E., Grand Rapids 8
American Metal Processing Co.
12000 East Nine Mile Road, Van Dyke

MINNESOTA

Metallurgical, Inc.
900 East Hennepin, Minneapolis 14

MISSOURI

Metallurgical, Inc.
1915 Tracy Ave., Kansas City 8
Lindberg Steel Treating Co.
650 East Taylor Ave., St. Louis 15
Paulo Products Co.
5711 West Park Ave., St. Louis 10

NEW JERSEY

Ace Heat Treating Co.
611 Grove St., Elizabeth
American Metal Treatment Co.
Highway 25 and laFayette St., Elizabeth
Benedict-Miller, Inc.
Marin Ave. and Orient Way, Lyndhurst
Bennett Steel Treating Co.
246 Raymond Boulevard, Newark 5
L-R Heat Treating Co.
107 Vesey St., Newark

NEW YORK

Fred Heinzelman & Sons
138 Spring St., New York 12
Alfred Heller Heat Treating Co., Inc.
391 Pearl St., New York 38
Metro Heat Treat Corp.
466 Broome St., New York 13
Lindberg Steel Treating Co.
620 Buffalo Road, Rochester 11
Rochester Steel Treating Works
962 Main Street, E., Rochester 5
Syracuse Heat Treating Corp.
1223 Burnet Ave., Syracuse 3

OHIO

Cincinnati Steel Treating Co.
Wooster Pike & Mariemont Ave., Cincinnati 27
Queen City Steel Treating Co.
2980 Spring Grove Ave., Cincinnati 25
Ferrotherm Co.
1861 E. 65th St., Cleveland 3
Lakeside Steel Improvement Co.
5418 Lakeside Ave., Cleveland 14
George H. Porter Steel Treating Co.
1265-71 East 55th St., Cleveland 14
Reliable Metallurgical Service, Inc.
3827 Lakeside Ave., Cleveland 14
Winton Heat Treating Co.
20003 West Lake Road, Cleveland 16
Dayton Forging & Heat Treating Co.
2323 East First St., Dayton 3
Ohio Heat Treating Co.
1100 East Third St., Dayton 2

PENNSYLVANIA

Robert Wooler
Limekiln Pike, Dresher
J. W. Rex Co.
834 West Third St., Lansdale
The Drever Company
220 West Cambria St., Philadelphia 33
Lorenz & Son
1351 N. Front St., Philadelphia 22
Metlab Company
1000 East Mermaid Lane, Philadelphia 18
Wiedemann Machine Co.
4272 Wissahickon Ave., Philadelphia 32
Ferrotherm Company
4911 Butler St., Pittsburgh
Pittsburgh Commercial Heat Treating Co.
49th St. and A.V.R.R., Pittsburgh 1

TEXAS

Cook Heat Treating Co., of Texas
6233 Navigation Boulevard, Houston 11

WISCONSIN

Metal Treating, Inc.
720 South 16th St., Milwaukee 4
Supreme Metal Treating Co.
4440 West Mitchell St., Milwaukee 14
Thurner Heat Treating Co.
809 West National Ave., Milwaukee 4
Wesley Steel Treating Co.
1301-1403 West Pierce St., Milwaukee
Harris Metals Treating Co.
1635 Murray Ave., Racine

Institute News . . .

1953 ANNUAL MEETING

This year's Annual Meeting held at the Hotel Carter, Cleveland, Ohio on October 16th, 17th and 18th was probably the largest and most successful to date judging from the attendance and number of important actions taken by the members represented.

During the first two days of the meeting, the following technical sessions were held:

"Pressure Nitriding" by G. E. Mohnkern, Oil Well Supply Division, U. S. Steel Company

"New Developments in Flame Hardening" by Virgil Bullen, Cincinnati Milling Machine Company

"Forging in Closed Dies" sound movie presented through the courtesy of the Drop Forging Association

"Principles of Heat Treatment," sound-slide film presented through the courtesy of the Meehanite Metal Corporation.

Cliff M. Cook, President, Metal Treating Institute

Committee reports were presented by Horace C. Knerr, Publication Committee; Fred Heinzelman, Jr., Heat Treating Hints Committee; and Secretary Herington read the report of the Cost Accounting Committee in the absence of the Chairman, Purdy Benedict. This report was followed by a Round Table Discussion on Costing.

Plant visitations were made to Reliable Metallurgical Service, Inc., Ferrotherm Company, George H. Porter Steel Treating Company and Lakeside Steel Improvement Company. Refreshments and a buffet supper were served at the Lakeside plant.

The last day of the meeting was devoted to a business session at which several new measures were voted into effect. Among these were: a special financial assessment to increase the emergency reserve of the Institute; the establishment of a special fund to be devoted to research projects; the establishment of an annual award to the author of the best paper appearing in *Metal Treating* or presented at an MTI meeting. Complete minutes of the business session covering these subjects will be available soon.

(Continued on page 27)

The annual banquet, always an enjoyable and popular affair, was made even more so by the comments of Bennet Cerf, noted humorist and TV star. There were 125 people attending, giving some idea of the overall success of this meeting.

Thermalloy retorts with bayonet-type plug end on the left. Firebricked ends of carbon steel retorts on the right were sealed over with clay paste before use.

THERMALLOY*

outlasts carbon steel retorts . . . 28 to 1

In a plant of a large eastern tool and specialty steel manufacturer, long, pipe-like retorts are used to anneal and heat-treat high-speed carbon and alloy steel bar stock in hood-type furnace equipment. Temperatures range up to 1650°F. during the annealing or heat-treating cycle that may last 30 hours.

Under these conditions, this manufacturer found that wrought carbon steel retorts scaled excessively and also distorted and flattened during operation . . . limiting service life to about 500 cycle hours. For the same operation, centrifugally cast Thermalloy retorts showed no measurable scale loss and maintained uniform wall thickness and shape. When last reported, Thermalloy retorts had been operating over 14,000 cycle hours and were still in perfect condition.

As the wrought carbon steel retorts became distorted, the plugs necessary to seal the open ends would not fit. Firebrick and a clay paste were used to seal the ends against infiltration of furnace gases. This made uniform annealing or heat-treating practically impossible. However, Thermalloy retorts, with plug ends designed by Electro-Alloys, afforded practically gas-tight seals and much greater ease of handling.

Today, this manufacturer is replacing all of the wrought carbon steel retorts with high heat-resistant Thermalloy retorts. Perhaps the same operating economy may interest you in Thermalloy retorts, furnace parts, trays, racks, pots or muffles. For full information, call in an Electro-Alloys engineer or write Electro-Alloys Division, 4003 Taylor Street, Elyria, Ohio.

*Reg. U. S. Pat. Off.

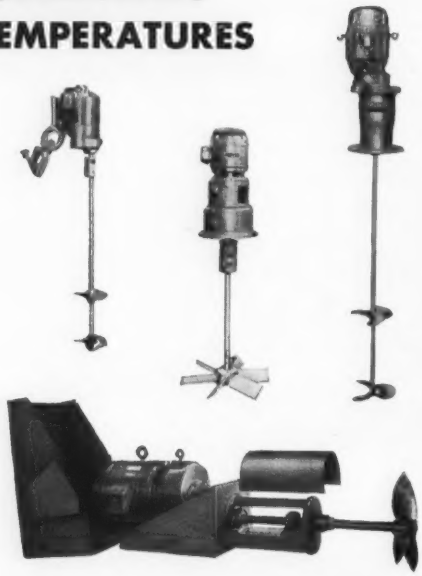
AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION
ELYRIA, OHIO

DEVINE AGITATORS

ASSURE

UNIFORM QUENCHING TEMPERATURES



- Provide proper circulation of quenching liquid.
- Help equalize quenching strains.
- Compact. Self-contained. No piping required.
- Unusually sturdy. Built for plenty of use.
- Easy to install. Easy to detach. Easy to maintain.

Devine Engineers will be glad to recommend a type and size to fit your tank.

J. P. DEVINE MFG. CO.

A. M. Cox, President

49th St. and AVRR · Pittsburgh 1, Pa.

Devine AGITATORS

water condensed on a measuring device. The condensation temperature is measured electrically then indicated, recorded and controlled.

Using standard attachments the controller can be fitted to any controlled atmosphere furnace. Ammonia in the furnace atmosphere will not affect its accuracy and the electronic element of the unit can be replaced without difficulty. The instrument does not require calibration.

Super Scottsonizing

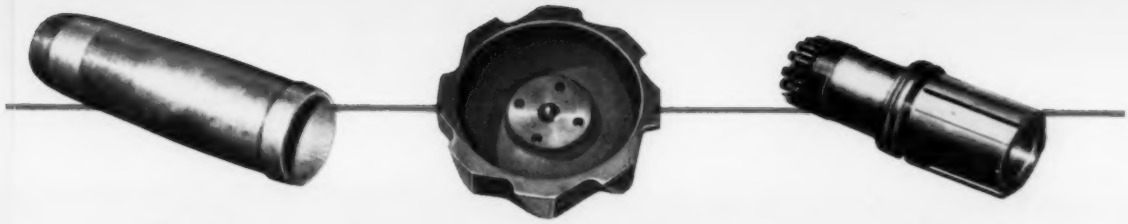
C. U. Scott & Son, Inc., Rock Island, Ill., had on display samples of stainless steel parts hardened by the Super Scottsonizing process which results in a Brinell hardness higher than a diamond. Cut-a-way models of equipment using parts hardened by the process were also shown. Featured in the exhibit

was a painting entitled, "The Iron Worker and King Solomon" with the following caption, *"When the temple at Jerusalem was completed King Solomon gave a feast to the artificers employed in its construction. On unveiling the throne, it was found that a smith had usurped the seat of honor on the right of the King's place not yet awarded, whereupon the people clamored and the guard rushed out to cut him down. "Hold, let him speak," commanded Solomon. "Thou hast, O King, invited all craftsmen but me. Yet how could these builders have raised the temple without the tools I fashioned?" "True," decreed Solomon, "the seat is his of right."—All Honor To The Ironworker.*

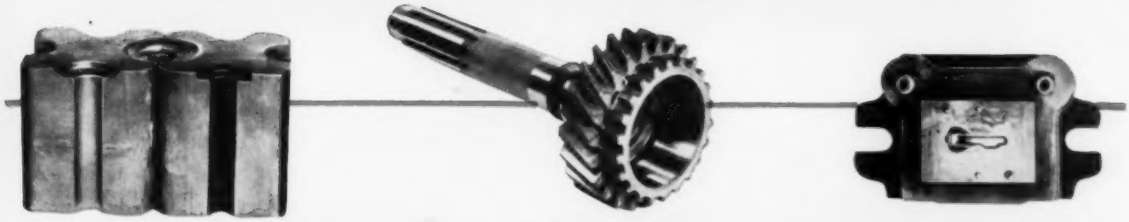
Nickel-Chrome-Boron Brazing

The Ferrotherm Company, Cleveland 3, Ohio, one of the world's largest commercial brazing plants, featured stainless steel brazing, both copper and nickel-chrome-boron, as well as bright hardening and annealing of stainless steel.

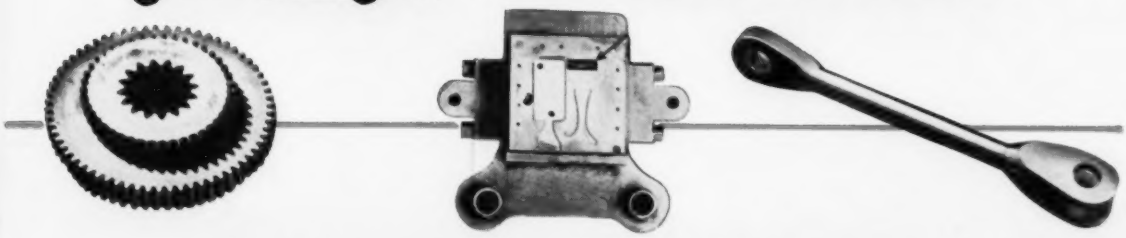
In the relatively new field of nickel-chrome-boron brazing of stainless steel, Ferrotherm had on display, aircraft exhaust valve seats, nozzle diaphragm assemblies, and Inconel X brazed vane assemblies which are being done in production quantities. Also on exhibit and attracting much attention were some of the 400 Series stainless steel screws and fasteners. ■ ■ ■



When heat treating troubles



get tough, it's time to turn



to HOUGHTO-QUENCH

the Fastest Quench this side of Water!

The properties you need for speedier, surer quenching demanded today are in Houghto-Quench. Any steel . . . even today's low alloy steels . . . gets uniform deep hardness in the Houghto-Quench bath.

Houghto-Quench has rapid wetting out ability . . . faster draining . . . less drag-out, hence lower cost per ton of steel quenched. It maintains proper fluidity in the bath. It dissipates heat quickly to give you faster quenching through the critical zone. Exceptional stability and oxidation resistance are assured by the Houghto-Quench formula.

Get further information from the Houghton Man — or write to E. F. Houghton & Co. Philadelphia 33, Pa.

One Source . . . for all heat treating needs.

See "Liquid Salt Baths" —our latest booklet covering heat treating salts for carburizing, neutral hardening, annealing, tempering, martempering and other heat treating operations. Get a copy.

HOUGHTO-QUENCH

. . . a product of

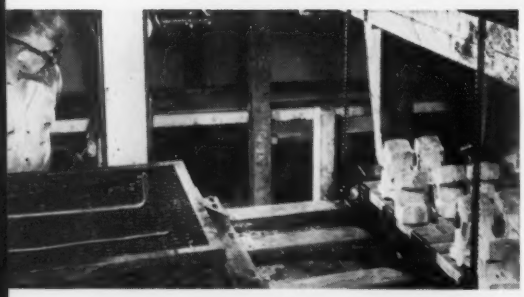
E. F. HOUGHTON & CO.

PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

Picture shows how oil that forms sludge can clog cooler. Sun Quenching Oil's natural detergency helps prevent such sludge formation.

Oil Coolers Don't Clog with



A New England firm uses five 2400-3000 gallon systems to quench all types and sizes of aircraft and automotive forgings. Since Sun oil was adopted 7 years ago, not one system has required cleaning except for normal removal of mill scale.

Sun Quenching Oils keep oil coolers clean. Teardowns are fewer and maintenance costs less. This is because Sun oils have a natural detergent action that prevents the formation of sludge and aids in removing any deposits that exist.

Can Handle 95% of All Quenching Jobs

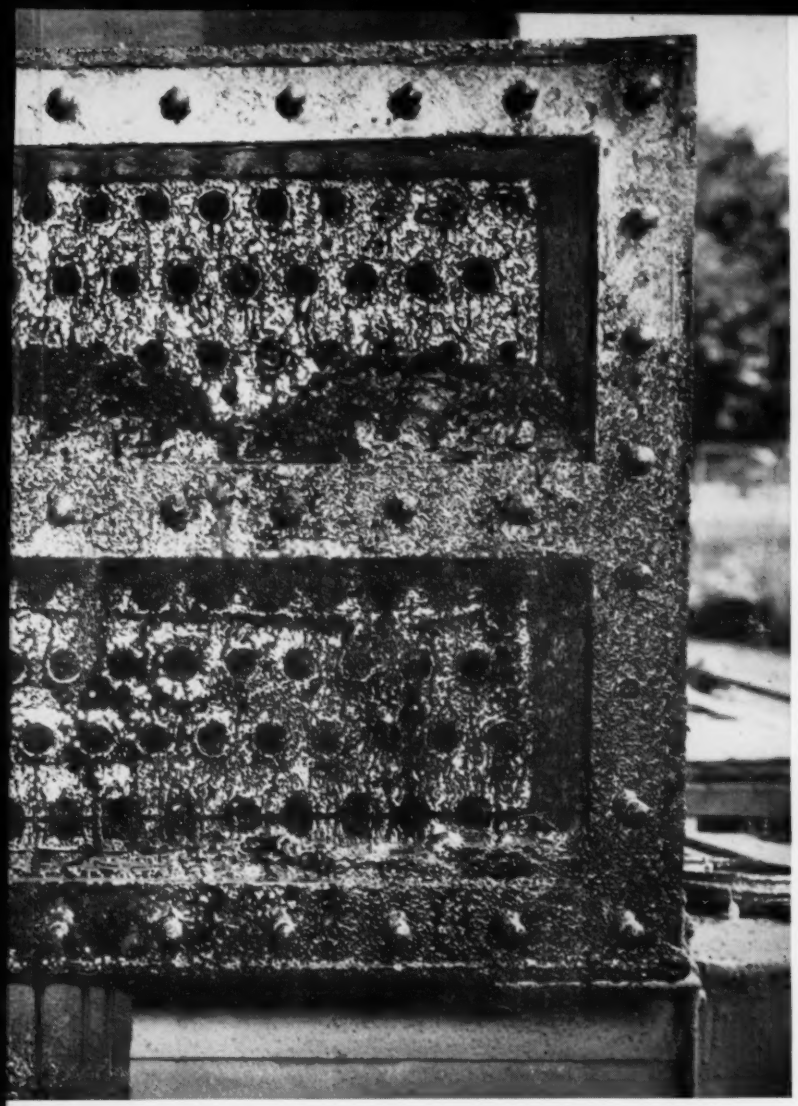
Tests show that Sun Quenching Oils give better all-around results. For one thing, they assure hardnesses far above the commonly accepted minimum requirements. In any system that provides normal agitation, they can handle 95 per cent of all quenching jobs.

C. R. Weir, Vice-President, Metal Treating Institute

The election of new officers and trustees for the year 1954 was held on October 18th. Cliff M. Cook, Cook Heat Treating Company of Texas, was elected President; C. R. "Bob" Weir, Commonwealth Industries, Inc., was elected Vice-President; and Lloyd G. Field, Greenman Steel Treating Company, was re-elected Treasurer. The new trustees are Harvey L. Miller, B-M Heat Treating Company; Ken U. Jenks, Lindberg Steel Treating Company (Melrose Park, Ill.); Clarence F. Graham, Metal Treating, Inc. Trustees also remaining in office are A. E. Leidig, Hollywood Heat Treating Company; C. H. Muehlemeyer, O. T. Muehlemeyer Heat Treating Co.; Fred Heinzelman, Sr., Fred Heinzelman & Sons.

Fred Heinzelman, Sr., will serve his second year as a Trustee along with A. "Ernie" Leidig and Carl H. Muehlemeyer.

(Continued on page 32)



Sun Quenching Oil

Sun Quenching Oils Reduce Operating Costs

Sun oils thin out when heated, drain off parts faster and more completely. Dragout is reduced to a minimum. They do not thicken up, and under normal operating conditions need never be replaced. For more information about Sun Quenching Oils, call your nearest Sun office or write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. MR-11.

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

SUNOCO

PHILADELPHIA 3, PA. ◆ SUN OIL COMPANY LTD., TORONTO & MONTREAL

MISCO HEAT RESISTING ALLOY FIXTURES

Michigan Steel Casting Co.

DIVISION OF EBALOY, INCORPORATED

One of the World's Pioneer Producers of Heat and Corrosion Resisting Alloys

1999 GUOIN STREET
DETROIT 7, MICHIGAN

MISCO
Heat and Corrosion Resistant Alloys

WHAT'S YOUR PROBLEM?

ED. NOTE: Frequently "*Metal Treating*" is asked for answers to heat treating problems of various types. These are referred to technicians, metallurgists, etc. The correspondence below is typical.

Send us *your problem*—we'll try to get the answer and publish it for your benefit and others.

Gentlemen:

We are the manufacturers of poultry equipment and picnic jugs and quite recently we purchased a new plant from the General Tire and Rubber Company which contained a heat treating plant. They did their own heat treating and some commercial work. The heat treating plant was Air Corps approved inasmuch as General Tire was doing work for them.

Since we have had no experience with this type of work, we would appreciate very much any information you could give us that might help in getting started with commercial heat treating. We would especially appreciate advice regarding a good man to supervise the plant as well as marketing and advertising procedures.

Yours very truly,
WILLIAM R. BOLTON
Works Manager
The Royal Manufacturing Co.
Bowling Green, Ohio

Editor's Note: We have printed the above letter here since the best answer to this problem would be direct response by interested firms or persons to Mr. Bolton at the address given above.

Gentlemen:

After heat treating metal and then completing the plating process we seem to have some difficulties in relieving the Hydrogen from same and are wondering if you have some literature, textbooks or other information whereby we can eliminate this trouble.

Any information forwarded to

(*Continued on page* 31)

more for your money - - -

HOLDEN SALT BATHS and INDUSTRIAL POT FURNACES

Holden Type 701 Electrode Furnaces

. . . provide these Important Advantages

1. **Electrodes are completely separated** from the working area of the furnace. The brick structure is so designed that it is impossible for work to come into contact with electrodes, either in the basket or work holding fixture.
2. **Electrodes are easily replaceable.** The overhanging ledge permits repair or replacement without disturbing the refractory.
3. **No water cooling of the furnace wall** is required, so there is no power loss with this design.
4. **Split design electrode assembly,** an exclusive development of the Holden Company, provides 80% more area over which to carry secondary current.
5. **A 15 to 20% improved efficiency** is possible when this type electrode assembly plus the flexible braid for transmission of secondary power is used on competitive furnaces.
6. **A single bolt connection for water cooling** the electrode assemblies prevents oxidation of the copper to copper connection. Similarly with such water cooling of these terminals there is no possibility of inducing the heat from the furnace back to the transformer.

• SAVE ONE THIRD On Your Present Furnace

Any competitive furnace using the older type construction can be converted to this design with an electrical saving of approximately 33 1/3%.

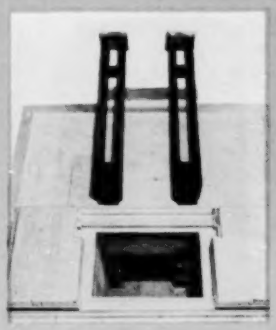
INVESTIGATE THE HOLDEN LEASE PLAN

1. It will save you **one-third** over direct purchase and depreciation.
2. No capital investment required.

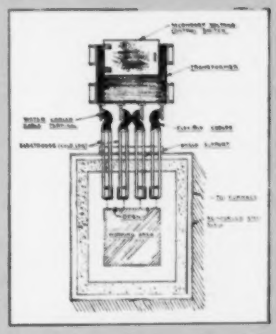
For full information, write or phone:

J. B. Carey—Detroit, TExas 4-8127

M. R. Boyle, New Haven—State 7-5885



HOLDEN TYPE 701-2 Submerged Electrode Unit with removable electrodes.



Drawing of HOLDEN TYPE 701-4 Submerged Electrode Furnace.

HOLDEN TYPE 701-4 Submerged Electrode Unit with replaceable electrodes.

Three f.o.b. points: Detroit, Michigan—New Haven, Conn.—Los Angeles, Calif.

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3311 E. Slauson Ave.
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Detroit 27, Michigan

These features assure that any contaminating vapors are condensed or drawn off before they have a chance to work up into the furnace. The exhauster also continuously draws furnace atmosphere well down into the quench chute. Thus, the work is bathed in high-purity atmosphere until the very instant it strikes the quench medium.

The furnace shell, or casing, is made of 3/16" plate continuously welded at all seams to hold protective atmosphere and reinforced with structural members to provide a fully portable unit, that is, one that may be skidded and moved at any time without danger of distortion. All detachable parts are fastened with studs and gasketed with sheet asbestos. Insulation averages about 9" total thickness composed of 4½" of 2500°F. insulating firebrick backed up with 4½" of preformed slab-type insulation. The furnace lining may generally be completely installed at the manufacturer's plant before shipment (See Fig. 4).

Heating elements are of the Nichrome (80% nickel-20% chromium) rod type, formed into return overbends and offset to stand off from the inner furnace walls. These elements are supported at each overbend with simple hanger pins. It should be noted that no special ceramic support pieces or alloy through-bolts are used. This permits the entire length of element to dissipate its heat energy and prevents localized over-heating. The complete absence of through-bolts eliminates conductive heat losses from this source and unnecessary furnace atmosphere leakage.

All elements operate through insulated dry-type transformers at applied voltages in the range of 70-120 volts. This permits the use of heavy wire diameters and practically eliminates any hazard from accidental shorting such as would be caused by the operator striking an element bank with a charging tool. Low potential between elements and furnace shell and between adjacent element banks assures a minimum of stray current leakage as might be caused by sooting or carbon buildup on the furnace lining after extended length of service.

For medium and large sized work, the furnace is generally provided with an air cylinder operated charging door. Parts may be either individually charged or else pre-loaded on a pan and pushed off onto the furnace belt in small "batches." For smaller parts lending themselves to hopper feeding, the furnace is provided with a hopper and feed trough with electromagnetic vibrating feeder. This feeder unit is furnished complete with control panel incorporating a percentage timer to set up rate of feed by varying percentage on-off time.

A wide variety of flight conveyor quench tanks are available. These can be furnished for water, oil, or hot salt for martempering and austempering applications. If desired, dual quench tanks can be used and the furnace mounted on wheels for cross travel to permit alternate oil and water quenching without need for draining tanks.

Furnaces of this type are available in a number of different sizes having either two or three furnace control zones. Though in most cases the individual zones are of approximately equal physical lengths, an effort has been made to allow as much input as possible in the incoming zone or zones, where the cold work can most readily accept heat energy. This increases furnace productive capacity by using to best advantage the fundamental principle that radiant heat transfer varies as the 4th power of the difference in absolute temperature between the furnace radiating surfaces and the cold work. By actual field test, the ideal breakdown of total input has been found:

2 zone furnaces—60%, 40%
3 zone furnaces—40%, 40%, 20%

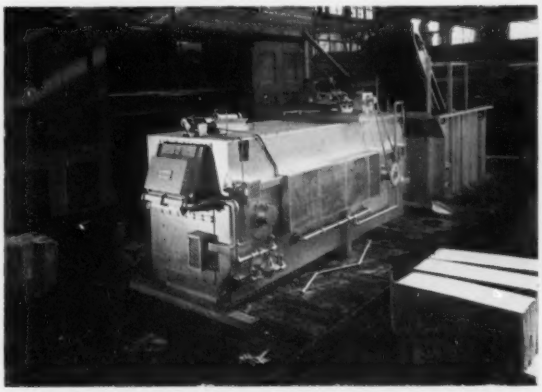

Fig. 4—Furnace and flight conveyor quench tank completely shop erected and loaded on flat car for shipment.

This breakdown has been maintained as closely as possible in actual furnace design. This means, then, that at full furnace production, each control zone is working equally hard and that contactor "percent on" time is essentially equal for the different zones.

By accurate field test on two independent installations of 24" wide x 9' long furnaces being run on straight hardening, it has been demonstrated that actual electric energy consumed averages about 0.110 KW or 110 watts per pound of work heated to 1500-1550°F. hardening temperature. Inasmuch as actual heat content of steel in this range is about 70 watts per pound, this indicates a furnace efficiency of about 63.5%. It should be noted that this figure takes into consideration all furnace heat losses including shell radiation losses, conductive through-metal losses, radiant losses through furnace openings, and heat required to bring controlled atmosphere from about 150°F. to furnace temperature. Efficiency figures on smaller furnaces are somewhat lower and on larger units somewhat higher than 63.5%. ■ ■ ■

What's Your Problem (cont.)

the personal attention of the undersigned will be appreciated.

FRANK BORIELLO
Plant Supt.
Suffern Plating Corp.
Hawthorne, N. J.

Gentlemen:

We have been forwarded a copy of your letter of July 29 addressed to the Metal Treating Institute regarding difficulties in relieving hydrogen after plating.

Normally, parts which have entrapped hydrogen are relieved by baking or boiling in extremely hot water; however, sometimes these processes are not successful. In such cases, the trouble may be found in the heat treating of the parts and the trouble should then be tracked down in the heat treating operation.

We hope that this will be of some help to you.

A. L. PIETROWICS
Promat Division
Poor & Co.
Waukegan, Ill.

Editor's Note: Mr. Boriello was also sent tear sheets of the article "Hydrogen and Heat Treatment" by Dr. Carl Zapffe which appeared in the July-August 1951 issue of Metal Treating.

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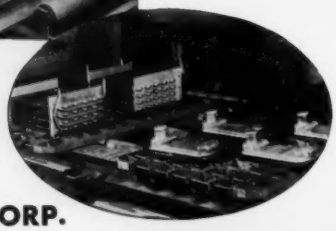
Rolock "Serpentine" Trays carry Condenser Units on powered rollers thru furnace, for brazing at 2050°F.



BRAZING TRAY life increased 140%
Maintenance *decreased* 100%
...at FEDDERS-QUIGAN CORP.

Rolock "Serpentine" furnace trays, built for this specific use, were furnished in two sizes . . . 24" x 30" (weight 22 lbs.) and 24" x 36" (26 lbs.). The maximum load carried by the larger tray is 80 lbs. . . . in brazing, an exceptionally good ratio of load to weight. Some trays are of type 330 stainless, others are of Incoloy.

Trays formerly used had a maximum life of 2500 trips thru the furnace. Rolock trays give a minimum of 6000 trips . . . then are rebuilt for additional service.

Former trays required maintenance by one full-time skilled worker and a part-time helper; "Serpentine" have required absolutely no maintenance. Moreover, other trays frequently jammed in the furnace, causing costly down-time of the whole line. "Serpentine," no jamming, no down-time.

The answer, of course, is in the fully articulated "Serpentine" construction which resists warping to the highest degree. If this is one of your problems, write Rolock for practical solutions.

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Institute News (cont'd)

The new officers were sworn in by the retiring President A. M. Cox. Mr. Cook, in accepting the office of President, said, ". . . Gentlemen, this is quite an honor and I hope that I live up to your expectations of serving as your President . . . I am happy to serve . . . and I will do my very best."

Newly elected Trustees are Ken U. Jenks (above), Harvey L. Miller (below) and Clarence F. Graham.

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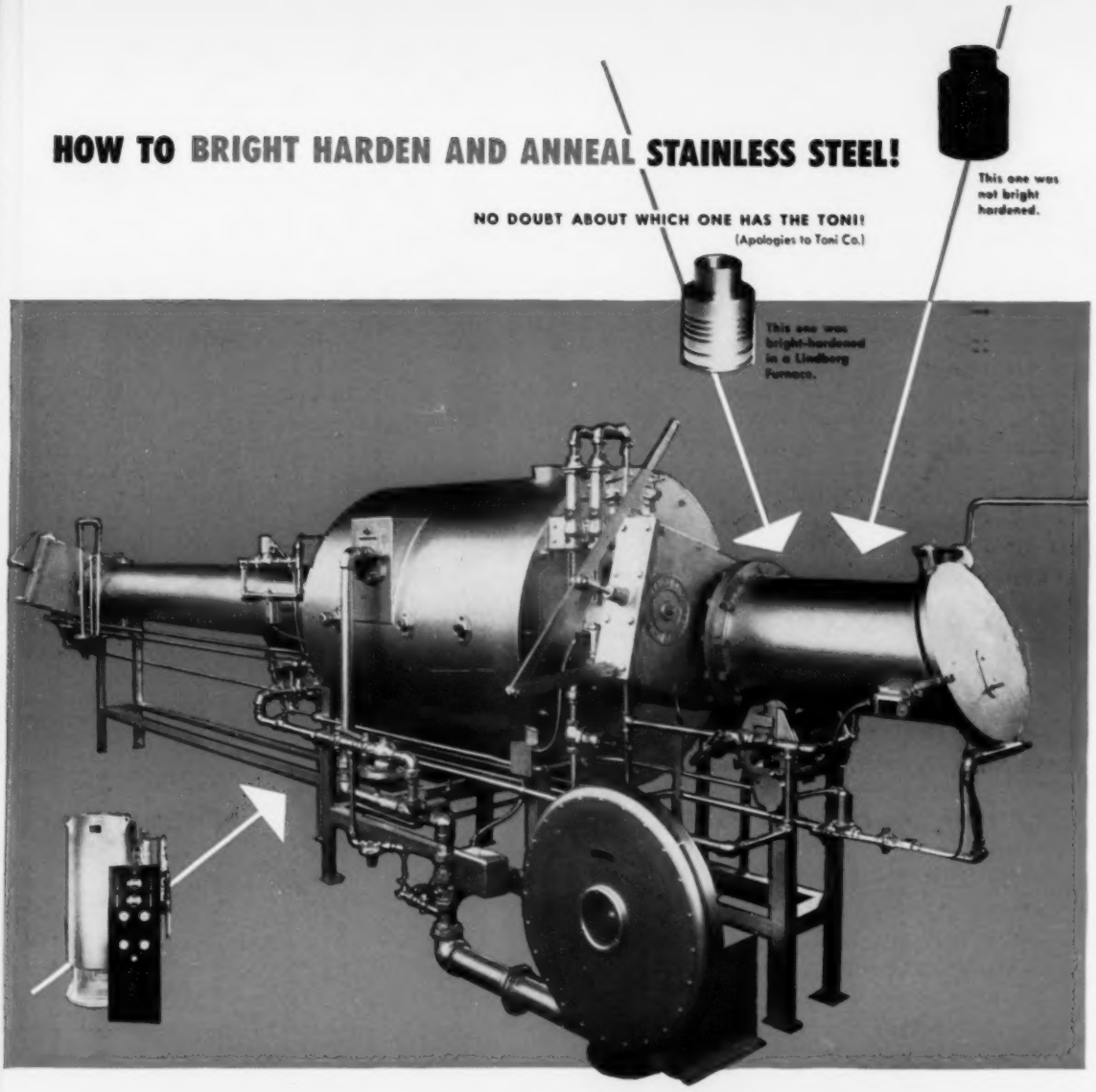

If your production requirements call for the bright heat treating of stainless steel, completely free from oxidation and discoloration . . you'll want to know more about this amazing Lindberg Stainless Steel Heat Treating Furnace, many of which have been in successful use throughout the country for 4 years. They are *specifically designed* for the heat treatment of stainless steels and other high alloy materials.

This process eliminates the need for operations such as pickling, sandblasting, and machining . . which are not only costly and time-consuming, but also often disturb the delicate balance of the alloying elements on the surface of the metal.

Lindberg Stainless Steel Heat Treating Furnaces are built with purging chambers at *both* the charging and the discharging ends. This eliminates the chance of work chamber atmosphere becoming contaminated by either oxygen or water vapor . . which will oxidize stainless steel.

These furnaces use protective atmosphere supplied by Lindberg HYAM Hydryzing Generators. Atmosphere consists of dissociated ammonia (75% hydrogen and 25% nitrogen . . dew point, minus 60°F).

Your "Lindberg man" will be glad to tell you more . . call him.

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treatment. In some cases, the aging portion of these treatments is designed to produce maximum hardness and the attendant higher tensile and yield strengths and lower elongation. Other aging treatments effect a compromise, providing somewhat lower tensile and yield strengths and hardness than are obtained with the foregoing treatments in order to retain higher elongations.

A third type of aging treatment is an intermediate temperature treatment following a solution treatment. The higher aging temperatures that are used produce a stabilized material. Such a stabilizing treatment results in precipitation in excess of that which imparts maximum hardness and tensile strength. The objectives of these treatments are to procure substantial freedom from growth in castings that are to be operated at elevated temperatures and substantial removal of any internal stresses.

Density change, or growth produced by aging, was discussed in connection with the first type of aging treatment. Residual internal stresses may be induced during quenching by excessively rapid cooling from the solution treating temperature. The presence of such internal stresses in castings may cause distortion during machining and, in special cases, might reduce the load-carrying capacity of the part. These stresses can be minimized by adherence to the proper quenching technique. They can be further reduced by use of a suitable aging treatment.

Some of the physical properties of aluminum casting alloys are a function of their thermal condition. The resistance to corrosion of wrought products of certain aluminum alloys is influenced by heat treating practices.[8] In general, differences in heat treatment or heat treating practices do not alter the resistance to corrosion of aluminum alloy castings to a degree that is of importance commercially. The thermal and electrical conductiveness of aluminum castings are materially influenced by heat treatment. Conductivity data on commercial casting alloys in different thermal conditions are available[5,6,9] for use in considering applications in which these physical properties are important.

Room Temperature Aging—Reference was made, in discussing precipitation treatment, to the fact that an unstable structural condition exists in solution treated aluminum alloy castings. It was also pointed out that the rate of precipitation occurring in adjustment toward equilibrium conditions is comparatively slow at room temperature. The aging that occurs in castings at room temperature usually is most marked in the first few days after quenching from the solution heat treating temperature. It proceeds at a slower rate over a long period of time.

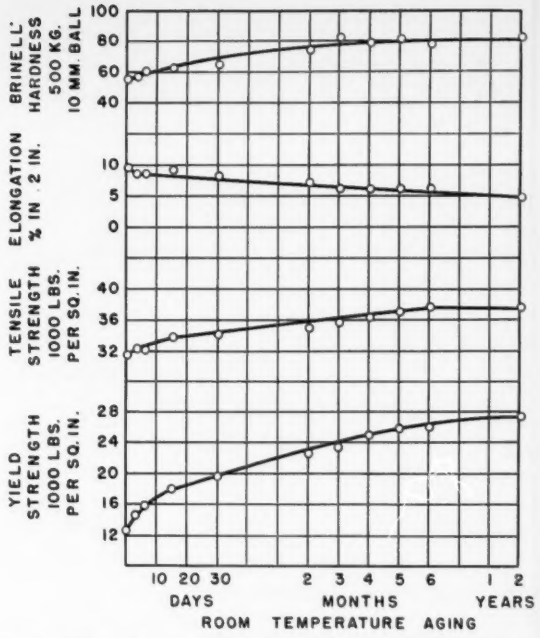

Fig. 9—Effect of room temperature aging on the mechanical properties of solution heat treated sand cast alloy 195. Standard ½" diameter test specimens.

Curves that show the effect of room temperature aging on the mechanical properties of two solution treated commercial aluminum casting alloys are provided in Figs. 9 and 10.

(*Continued on page* 37)

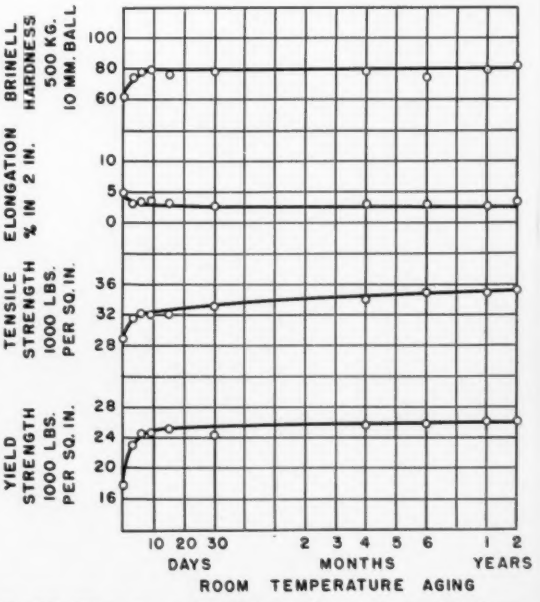

Fig. 10—Effect of room temperature aging on the mechanical properties of solution heat treated sand cast alloy 355. Standard ½" diameter test specimens.

Heat Treating ***ABSTRACTS . . .***

Quench Cracking in SAE Steels

The authors describe a method of determining the susceptibility of various steels to cracking. A test specimen had been developed which permitted a reasonable comparison between steels and quenching media. The steels tested are listed in Table I with their chemical analyses, hardenability ratings and martensitic transformation temperatures.

Table II lists the results of all tests for 22 SAE steels. The hardening temperatures, quench media and quench temperatures are listed at top from left to right in the order of their severity. Among the factors investigated which were felt to have influence on cracking were the following:

Composition—A study of P and S was made but the analyses could not be related to cracking. In general, however, non-metallic inclusions are stress raisers and thus contribute to cracking. Carbon content and its relation to the martensitic transformation temperature proved to be a major factor, higher carbon contents increasing the tendency to cracking. For example, quenching from 1475° F. in oil caused cracking in specimens of .50 carbon or more while quenching from 1650° F. in oil caused cracking if carbon exceeded .40.

Hardenability—A study indicated that cracking tendency increased with increasing hardenability. This is attributed to greater internal stress resulting from more severe volumetric changes in those steels which are fully martensitic after quenching.

Hardening Temperature, Quench Temperature and Media—The relative severity of each of these factors is shown in Table II. Various procedures are listed at top, from left to right, in the order of their decreasing severity.

(Abstract from "A Test for Measuring Quench Crack Sensitivity of Engineering Alloy Steels" by R. D. Chapman and Walter E. Jominy, *Metal Progress*, September, 1953.)

Steel	C	Mn	Si	Cr	Ni	Mo	P	S	D_1	M_S
4320	0.19	0.60	0.30	0.57	1.83	0.23	0.020	0.025	4.45	725
8730	0.30	0.85	0.36	0.56	0.47	0.21	0.017	0.028	4.45	679
4032	0.32	0.72	0.23	–	0.07	0.24	0.023	0.025	1.62	727
5130	0.34	0.89	0.33	1.00	0.19	0.05	0.011	0.020	4.46	637
1030	0.34	0.79	0.31	–	0.04	–	0.022	0.027	1.06	723
1330	0.34	1.68	0.33	0.08	0.09	–	0.025	0.022	2.7	652
4130	0.32	0.53	0.31	1.09	0.11	0.21	0.016	0.014	4.40	664
4037	0.38	0.88	0.30	0.02	0.20	0.22	0.011	0.025	2.2	672
5140	0.44	0.88	0.29	0.86	0.08	–	0.019	0.032	3.78	589
4053	0.51	0.81	0.29	–	0.01	0.25	0.013	0.023	2.30	598
8742	0.43	0.88	0.26	0.45	0.64	0.28	0.027	0.035	5.9	591
4140	0.41	0.85	0.21	0.92	0.11	0.22	0.025	0.033	6.0	594
1050	0.51	0.72	0.20	0.05	0.06	0.02	0.025	0.032	1.38	611
5150	0.45	0.84	0.31	0.86	0.22	–	0.015	0.025	3.9	581
1090	0.89	0.82	0.23	–	0.10	–	0.014	0.037	1.7	361
4063	0.60	1.17	0.30	0.17	0.15	0.33	0.022	0.030	5.5	495
1060	0.57	0.75	0.23	–	0.06	–	0.014	0.033	1.26	575
4340	0.42	0.71	0.30	0.77	1.81	0.22	0.019	0.024	8.0	549
1345	0.45	1.85	0.28	0.09	0.17	0.06	0.019	0.029	4.1	563
5160	0.62	0.89	0.33	0.80	0.14	–	0.010	0.028	4.4	473
4150	0.49	0.85	0.35	1.08	0.32	0.20	0.016	0.034	8.20	525
8750	0.54	0.91	0.26	0.46	0.52	0.24	0.018	0.038	5.90	521

Table I—Steels tested and their chemical compositions. D_1 is a measure of hardenability, Ms is the martensitic transformation temperature.

Quench: → / Medium: → / Temp.: →	1850 Oil 80	1650 Oil 80	1475 Oil 80	1850 Salt 300	1650 Salt 300	1475 Salt 300	1850 Salt 400
4320	o	o	o	ooo	o		
8730	oo	o	o				
4032	oo	o					
5130	oo	o					
1030	oo	o					
1330	xo	o					
4130	xo	o					
4037	x	oo	oo	o	o		
5140		xx	oo	o	o		
4053	x	x	o	o			
8742		xx	xxoooo	oo	o		
4140	x	xxxo	xxxxo	oooo	oo	o	
1050		xxxx	xxxx	oooo	oo		
5150		x	xx	oo	oo	o	o
1090		x	xx	ooo	oo		
4063		x	xx	oo	o		
1060		x	xx	xoo	oo		
4340	x	xx	xx	xxxo	xoo	oo	
1345		xx	xx	xx	oo	ooo	
5160		x	x	xx	oo	o	o
4150		x	x	xx	xxo	xooo	oooo
8750		x	x	x	xx	xxo	ooooo

Table II—The results of all tests are shown here. o = not cracked, x = cracked.

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No solid rectifiers and their subsequent sludging are needed. No fresh salt additions are required except to replace drag-out. Fluidity of salt is maintained like new and sluggishness caused by solid rectifiers is eliminated.

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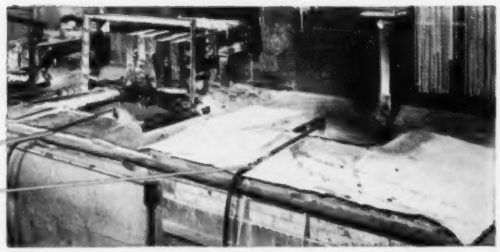
* Truly neutral chemically. Alkalinity can be maintained at zero.

At Commercial Steel Treating Corp., in Detroit, salt bath furnaces are daily cleansed of all impurities. Rectifying gas is bubbled into Park Nu-Sal Neutral Salt molten at its operating temperature of 1500°F.



Even high-speed hardening baths up to 2300°F. are easily maintained neutral. At Commercial, both pre-heat and high heat are rectified daily to zero alkalinity. Rectification is at 1850°F. in the high heat, done either on idling time or when furnaces are being used for hardening high carbon, high chrome die steels. Salt is Park Pre-heat 117, and Park High Heat 175-S.

Ansul Methyl Chloride (CH_3Cl) is a liquefied gas, 99.98% pure (by weight).
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Heat Treatment Of Aluminum Casting Alloys (Cont.)

Some of the treatments and alloys described in the foregoing are the subject of United States patents held by the company with which the authors are associated. ■ ■ ■

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News To Heat Treaters (Cont.)

Packaged Brazing Rings

A new method of packaging pre-formed brazing rings to speed up production brazing and to eliminate waste from bent ends and tangling has been developed by Alloy Ring Service, Inc., 1095 E. 52nd St., Indianapolis 5, Indiana. The unique packaging method offers extra value as a positive inventory control since quantities on hand can be easily determined.

Alloy brazing rings are being used extensively by Servel, Inc., manufacturers of domestic and industrial refrigeration and airconditioning equipment. Servel's Electrical Refrigeration Division has stated that the rings have offered superior performance. The packaging method which supplies the precision-made rings fitted on a cardboard tube or dowel rod has been responsible for the improved service claimed.

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16 kw	Van Norman	Metal	S. G.
20 kw	Thermatool	Metal	V. T.
25 kw	Thermatool	Metal	V. T.
30 kw	Thermatool	Metal	M. G.
50 kw	Westinghouse	Metal	M. G.
50 kw	Thermatool	Metal	M. G.
50 kw	Thermatool	Metal	V. T.
75 kw	R. C. A.	Metal	V. T.
100 kw	Gen. Elec.	Metal	M. G.
125 kw	Tocco	Metal	M. G.
150 kw	G.E.—Ajax	Metal	M. G.
600 kw	Gen. Elec.	Metal	M. G.
2 kw	Westinghouse	Non-metal	V. T.
5 kw	Westinghouse	Non-metal	V. T.
7.5 kw	Thermex	Non-metal	V. T.
25 kw	Thermatool	Non-metal	V. T.
50 kw	Thermatool	Non-metal	V. T.
125 kw	R. C. A.	Non-metal	V. T.

*V. T.—Vacuum tube; S. G.—Spark Gap; M. G.—Motor Generator

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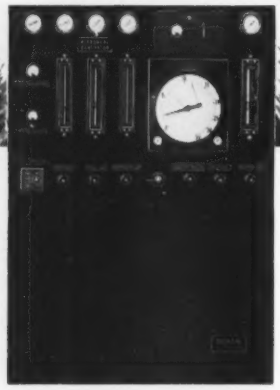

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NEW YORK • SAN FRANCISCO • LOS ANGELES • CHICAGO

LETTERS TO THE EDITOR

Dear Sir:

I would like to have the information on "Standards of Apprenticeship for the Heat Treater Trade."

I am a heat treater and have taught heat treating (basic) for the past four years. I am now employed with the Alameda Naval Air Station as a Heat Treat Supervisor of their Heat Treat Shop. I feel there is no reason why heat treating isn't a basic trade but for some reason in the past there has been difficulty in arriving at the knowledge and time spent at the trade in determining a suitable apprenticeship. Any information on this subject will be appreciated.

GEORGE POULOS
Oakland, California

Gentlemen:

Have read several copies of "Metal Treating" and find it very helpful.

Please tell me how I can be put on your mailing list.

HENRY P. HOVER
Heat Treat Dept.
Rheems Mfg. Co.
Burlington, New Jersey

Gentlemen:

I have recently received a copy of your "Metal Treating" magazine and was very pleased with its contents.

I am very closely associated with the heat treating business being Chief Metallurgist for a large gear company and would appreciate receiving this magazine.

RAYMOND R. FRITZ
Chief Metallurgist
AMgears, Inc.
Chicago, Illinois

Tempilstiks°

quick, simple, accurate way to tell temperatures

use like a crayon

It's this simple: mark the workpiece with the proper Tempilstik°. When the mark melts, the specified temperature has been reached.

to control working temperatures in:

- welding
- flame-cutting
- tempering
- forging
- casting
- molding
- drawing
- straightening
- heat-treating in general

$2 each gives up to 2000 readings

Available in these temperatures (°F)				
113	263	400	950	1500
125	275	450	1000	1550
138	288	500	1050	1600
150	300	550	1100	1650
163	313	600	1150	1700
175	325	650	1200	1750
188	338	700	1250	1800
200	350	750	1300	1850
213	363	800	1350	1900
225	375	850	1400	1950
238	388	900	1450	2000

Also available in pellet or liquid form

FREE —Tempil° "Basic Guide to Ferrous Metallurgy" — 16¼" by 21" plastic-laminated wall chart in color. Send for sample pellets, stating temperature of interest to you.

Metal & Thermit Corp. 100 E. 42nd Street, New York 17, N. Y.

Manufacturers' Literature . . .

The literature listed below contains information of interest to heat treating organizations. For your copy write direct to the manufacturer and be sure you mention seeing it reviewed in "Metal Treating."

PYROMETER CALIBRATION DATA

The Bristol Company, Waterbury, Conn., has announced the publication of their new issue of "Pyrometer Thermocouple Calibration Data," bulletin P1259. These new tables are based on data recently released by The National Bureau of Standards. Adopted by the Scientific Apparatus Makers Association and the Instrument Society of America, the new tables are corrected to the absolute volt and to the International Temperature Scale of 1948. The Iron-Constantan table has also been corrected to a new curve which has been adopted by SAMA.

KEYS AND SWITCHES

Complete information about keys and switches supplied by Leeds & Northrup Company, 4934 Stenton Ave., Phila. 44, Pa., for use in industrial or laboratory applications is now available in a new 12-page catalog, "Keys And Switches", just published. This new catalog describes how these keys and switches are being used to connect into low voltage circuits thermocouples, "Thermohm" or "Rayotube" detectors, conductivity cells, batteries, galvanometers, or other two or three-lead elements.

Included in this catalog are photographs and line drawings illustrating the design features of the keys and switches. To facilitate selection of switches, necessary dimensions and mounting directions are given. For easy reference, all specifications are arranged in tables.

THERMOCOUPLES, RADIATION DETECTORS AND RESISTANCE BULBS

Wheelco Instruments Division, Barber-Colman Co., Rockford, Illinois has published a new "Data Book and Catalog" covering their complete line of thermocouples, radiation detectors and resistance bulbs. The booklet contains a great deal of information on various sensing units as well as tips on instrument servicing.

The 42-page catalog also includes information on protection tubes, lead wire and other accessories for use with indicating, controlling and recording instruments. Nearly ten pages of the catalog are devoted to thermocouple calibration data, temperature conversion tables, etc.

NEW EDITION OF MEASURING EQUIPMENT CATALOG

A revised edition of the General Electric Company's 64-page measuring equipment catalog, containing information on more than 115 testing and measuring devices for laboratory and production line use, has been announced as available from the Company at Schenectady 5, N.Y.

The fully illustrated publication, GEC-1016A, contains information on products ranging from simple current indicators to completely automatic oscillographs; from surface roughness scales to mass spectrometers; from d-c amplifiers to radiation monitors.

The purpose of the catalog is to bring to the attention of its users the many measuring devices that can be used to increase the efficiency of their operations. A brief description of each product and its field of application, condensed tables of important characteristics and prices indicate whether or not the device is suited for a specific job.

Reference to more complete bulletins on each type of equipment also is included.

HARDENING STAINLESS STEEL

C. U. Scott & Son, Inc., Rock Island, Illinois, has just published an illustrated 64 page booklet on a method of hardening stainless steel. This booklet carries the intent of making this remarkable hardening process available to a greater number of American industries.

This hardening process, termed Super Scottsonizing, is a method of hardening precision stainless steel parts that will be subjected to excessive wear, as well as cutting tools. The parts are first machined, lapped and polished to the exact specifications. Then Super Scottsonizing hardens them to an estimated 2,000 Brinell without any change in physical quality. The size will vary less than ¼ of 1/10,000 of an inch.

The booklet explains methods and the procedure followed to prepare machined and cast stainless steel parts for the hardening process. Super Scottsonized parts are being successfully used by many of America's leading industries, in addition to army and navy ordnance plants.

WET-BLASTING

Complete information on deburring, die and mold polishing, blending grind lines, scale removal, honing of cutting tools and pre-plating cleaning with both regular velocity and high velocity wet-blasting equipment is available in a new, fully-illustrated, 8-page booklet issued by the Cro-Plate Co., Inc., 747 Windsor St., Hartford 5, Conn. Dozens of "before and after" photographs depict actual case histories and sections of the booklet are devoted to automatic, high-production rate machines, abrasives and Metal-Gard, a new rust preventative to be used following wet blasting operations.

VACUUM IMPREGNATION

A revised edition of a 24-page brochure on "Vacuum Impregnation" has just been released by F. J. Stokes Machine Company, 5500 Tabor Road, Philadelphia 20, Pa.

The new publication describes in detail a wide range of applications for this process by which voids in porous materials are filled with a desired impregnant after air and moisture have been evacuated. Among these uses are the sealing of metal castings against micro-porosity, the improvement of dielectric efficiency in electrical components and the potting of transistors.

The enlarged range of Stokes equipment for vacuum impregnating is described and complete specifications for standard cylindrical and rectangular impregnating chambers, storage tanks, and vacuum pumping units are contained in the new booklet, Catalog No. 760.

DIAL THERMOMETERS

A new 16-page bulletin, No. 467, describing dial thermometers for long distance measurement, has just been issued by The Foxboro Company of Foxboro, Mass. Emphasizing the variety of ranges, and the bulbs, tubing and accessories available, the bulletin provides complete data on temperature indicators of the vapor pressure and gas pressure types.

A separate section gives details of construction, helpful in understanding the precision performance of the instrument. Discussed in detail is the exclusive ball and trough movement which, by eliminating all connecting links, avoids loss of motion either up or down the temperature scale.

Both centigrade and Fahrenheit ranges are listed for Class II and III systems (vapor pressure and gas pressure)—a total of 94 ranges. Fahrenheit ranges cover all frequently-used scales from –300° to plus 600° in Class II and from –250° to plus 1000° in Class III. The method of determining which class of system to use for a given application is clearly explained.

CIRCULATION HEATERS

Typical applications and operating characteristics of Chromalox electric circulation heaters are featured in a new 8-page bulletin by Edwin L. Wiegand Company, 701 Thomas Blvd., Pittsburgh 8, Pa. The folder explains how the automatic circulation heaters provide automatically controlled heating of quenching media, air, steam and other gases for industrial processes.

These Circulation Heaters are packaged units complete with built-in elements, heating chamber, thermostat, insulation and mounting lugs. They are ready to attach to pipe lines leading to oil or water tanks, processing kettles, revolving rolls, storage tanks, etc.

Photos and drawings show methods of installation and advantages of the packaged units for a wide variety of installations.

HEAT TREATING HANDBOOK

Announcement of a new pictorial handbook on scientific steel treating services for industry has been announced by The Lakeside Steel Improvement Co., 5418 Lakeside Avenue, Cleveland 14, Ohio.

Described as a simplified guide to metal treating services by C. W. Derhammer, Lakeside's President, the new brochure illustrates the latest steel treating devices, methods and applications pictorially and with brief meaningful paragraphs.

Types of treatment described in the brochure are flame hardening, induction hardening, heat treating, carbonitriding, nitriding, liquid, gas and pack carburizing, chapmanizing, cyaniding, bar stock treating and straightening, normalizing, annealing and stress relieving, shot or sand blasting, and inspection and testing. This is a full range of steel treating services offered by the Cleveland firm. A hardness conversion table is also included.

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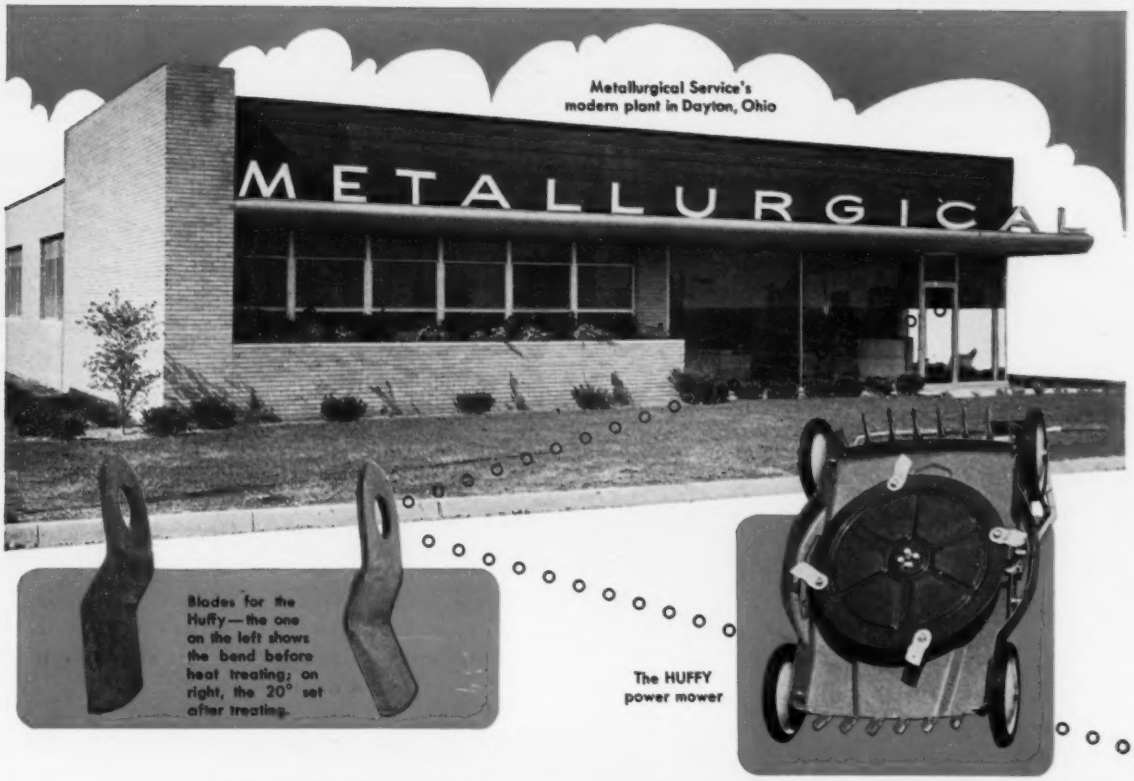
Metallurgical Service's
modern plant in Dayton, Ohio
METALLURGICAL
Blades for the Huffy—the one on the left shows the bend before heat treating; on right, the 20° set after treating.
The HUFFY
power mower

Metallurgical Service meets tough specs for Huffman mower blades with AEROHEAT® 1000 and AEROHEAT® 300 Heat Treating Compounds

Huffman Manufacturing Company of Dayton, Ohio, makes the HUFFY line of electric and gasoline power mowers. Four blades like those illustrated are used in each mower.

Here are their blade specifications—rigid ones that are checked statistically for each batch of blades:

1. Hardness—uniform 48-52 Rockwell C
2. Bend—blades must take a 20° set, which means they must be bent to about 30°
3. Peening—there must be no evidence of radial cracking after a two-pound weight drops three feet onto the cutting edge.

Metallurgical Service Inc., austempers these tool steel analysis blades at their modern Dayton plant using AEROHEAT 1000 and quenching them into AEROHEAT 300.

The high stability of AEROHEAT 1000 combined with the excellent quenching power of AEROHEAT 300—plus careful handling of a tricky job—permits Metallurgical Service to meet their customer's exacting requirements. Why not get the details on AEROHEAT 1000 and AEROHEAT 300? They may help you with your heat treating problems.

Cyanamid's heat treating compounds include:
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other products for metal processing include:
AEROBRITE® Metal Processing Aid
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MT-12

AMERICAN Cyanamid COMPANY

INDUSTRIAL CHEMICALS DIVISION
30 Rockefeller Plaza, New York 20, N. Y.

☐ Send data sheets on AEROHEAT 1000 and AEROHEAT 300
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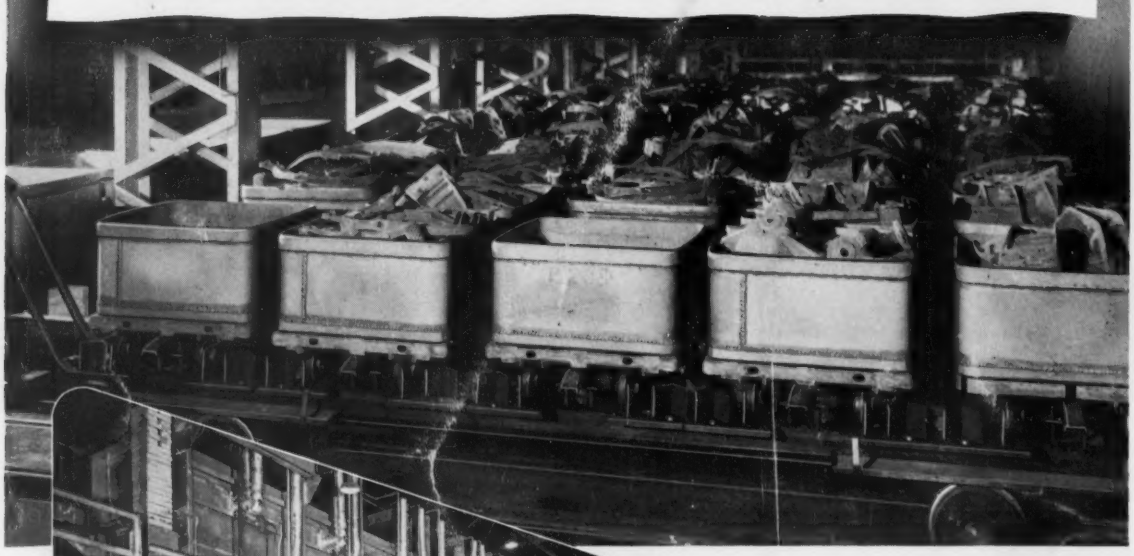
PSC *"Light Weight"* ANNEALING BOXES CUT HANDLING AND HEATING TIME



Left, a battery of 3 HOLCROFT overhead malleablizing furnaces at a large midwest foundry. Above, PSC boxes on the floor level, ready for elevating into a furnace.

Designed for use with conveyor-fed furnaces, the above PSC "Light-Weight" annealing boxes handle rapidly and easily through any load, unload, transfer or switch movement possible on a 90° conveyor.

Weighing only a small fraction of their 500-lb. load, these PSC "Light-Weight" containers not only save handling time but also effect impressive savings in heating time and fuel. Size 24" x 24", they are pinned to trays fitting roller rails. Fabricated of the sheet alloy which best stands the atmosphere and temperature conditions, these boxes have been in continuous 60-hour anneals for a great many months without significant distortion or embrittlement. PSC sheet alloy equipment fabricated for every purpose: annealing and carburizing boxes, covers, baskets, fixtures, retorts, tubes, etc.

Send for Heat Treating Catalog 52

A new standard reference

THE PRESSED STEEL COMPANY

of WILKES-BARRE, PENNSYLVANIA

Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

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C51